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ELECTRONICS AND ELECTRICAL ENGINEERING
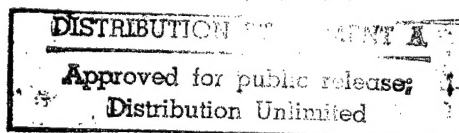
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USSR REPORT

Electronics and Electrical Engineering

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ACOUSTICS SPEECH AND SIGNAL PROCESSING

STATISTICALLY OPTIMAL ESTIMATION OF A PROCESS BASED ON READINGS DISTORTED
WITH NON-GAUSSIAN NOISE

[Article by M.A. Marinenko]

[Abstract] A study is made of the problem of constructing an extrapolation
estimate of a random process for a case with quite general measurement
error distribution density. The extrapolation algorithm constructed for
estimation of random processes based on their discrete measurements in the
presence of non-gaussian noise is optimal. The algorithms obtained for the
estimation are significantly superior to the method of extrapolation restora-
tion of zero and first-order polynomials based on the dispersion of error,
and guarantee a maximum error within the δ_1 corridor by rejecting anomalous
observations. References: 7 Russian.

QUASIOPTIMAL ALGORITHM FOR SIGNAL DETECTION AND PARAMETER MEASUREMENT AT
THE OUTPUTS OF ANTENNA ARRAY ELEMENTS OPERATING IN A HETEROGENEOUS MEDIUM
WITH CORRELATED NOISE

[Article by A.F. Maslov and K.P. Nesterov]

[Abstract] The purpose of this work was to extend an algorithm obtained
in an earlier work to cover the case of combined exposure to independent
noise and spatially correlated noise, as well as to solve the problem of

detecting the useful signal under these conditions at the outputs of elements of an antenna array. The quasioptimal algorithm synthesized for combined detection and estimation of amplitude and phase of the useful signal, assumed to vary in a random manner over time and space, with noise present in the antenna array elements yields a multichannel correlation-compensation system for measuring the coefficient of expansion of spatial fluctuations in amplitude and phase. The system used in the work of presenting the parameters of the signals as orthogonal functions with random coefficients allows more effective organization of processing by considering the spatial correlation of amplitudes and phases. Figures 3, references: 5 Russian.

CHARACTERISTICS OF OPTIMAL DETECTOR FOR WEAK NON-GAUSSIAN SIGNALS AGAINST A BACKGROUND OF WHITE NOISE

[Article by V.M. Shlyakhin]

[Abstract] A previous work defined the structure of a receiver for optimal detection of non-gaussian signals against a background of additive noise with asymptotically great instantaneous power. This work is dedicated to determination of the operating characteristics of such detectors. Calculations of the probability of detection using such an optimal detector show that nonlinear processing of the mixture of signals and noise received according to a rule presented in this article corresponds to a loss in the probability of detection of a weak non-gaussian signal in comparison to the optimal detection receiver, the operating characteristic of which is presented in an equation. References: 6 Russian.

SYNTHESIS OF OPTIMUM FILTER FOR EXTRACTION OF REFLECTED SIGNAL

[Article by V.I. Baburov]

[Abstract] One of the principal sources of error in the goniometric channels of radio engineering systems for short-range navigation is reflected-type interference, which pertains to additivity, i.e., at the reception point one or several interfering signals are combined. The article considers the possibility of detecting reflected-type interference by means of the presence of a derived direct signal in the structure of the input action. An optimum filter is synthesized for extraction of reflected-type signals on a background of a direct signal and fluctuating noise. Figures 2; references: 4 Russian.

INCREASE OF CLOCK FREQUENCY OF M-SEQUENCES

[Article by A.A. Bessarabova]

[Abstract] Summation or switching of the outputs of several generators with clock frequencies biased in phase are ordinarily used for an increase of the clock frequency of pseudorandom sequences (PS). The initial generators are able to form identical or different PS. Shifted copies of M-sequences are used as the initial PS, which is due to the simplicity of their generation. The problem often arises of obtaining the same M-sequences with an increased clock frequency; this is not possible with all of the relative shifts of the original copies. The article solves the problem of determining these shifts, as well as the shift and number of the resultant M-sequence, by the use of both a modulus of 2 and a commutator for forming an output PS. References 6: 4 Russian, 2 Western (1 in Russian translation).

SCATTERING AND ABSORPTION OF WAVES DURING PARAMETRIC INTERACTION WITH
WAVEGUIDE MODES

[Article by A.I. Smirnov, Institute of Applied Physics, USSR Academy of
Sciences]

[Abstract] Parametric interaction of waveguide modes at frequency $1/2\, \omega_0$
propagating along a plane-parallel layer of a homogeneous nonlinear medium
and normally incident monochromatic nonuniform waves at frequency ω_0 is
analyzed in accordance with the Brillouin concept, waveguide modes being
represented as a superposition of two plane waves, for a medium with a weak
quadratic nonlinearity. The corresponding standard system of short equations
is analyzed in the phase plane for solutions describing reflection and
absorption in the cases of unilateral and bilateral incidence. Unilateral
incidence converts an only transmitting and absorbing layer into an only
reflecting and absorbing one, as the excitation intensity increases from an
interaction threshold level to an interaction saturation level, while bi-
lateral incidence of equal intensity can result in its absorption only
with complete transformation into waveguide modes. The analysis is readily
extended to a smoothly nonhomogeneous waveguide layer and to oblique incidence
of pumping waves. The conclusions are then applicable to interaction of
intense electromagnetic radiation and a nonhomogeneous plasma. The author
thanks G.V. Permitin and V.V. Kurin for interest and helpful discussions.
Figures 6; references: 5 Russian.

NONCONVENTIONAL 'THREE-BEAM' DESCRIPTION OF LONG-WAVE PROPAGATION DURING TWILIGHT PERIODS

[Article by G.F. Remenets and V.A. Khidekel, Leningrad State University]

[Abstract] Anomalous variations in the reception of long-wave signals during da n when signals come from a source 100-1000 km away and beginning even earlier when signals come from a source 1000-2000 km away, is hypothetically explained on the basis of a "multibeam" ionospheric signal. A numerical analysis of the process indicates that during some initial stage of sunrise there can exist not only one but three paths for single reflection by the ionosphere. This numerical analysis was based on the model of a cylindrical waveguide between a cylindrical lower wall with a radius equal to the radius of the earth α = 6375 km and an upper boundary of variable altitude

$$h = r - \alpha = r_0 + 8 \tan^{-1} 2 \cdot 10^4 \frac{\phi - \phi}{1} 0 - \alpha \quad (\phi_0, r_0- \text{coordinates of the center}$$

of the twilight zone, r_0 = 6447.5 km, 1- characteristic length of the twilight zone). Movement of the twilight zone was simulated by discrete sampling of angles ϕ_0, whereupon the locus of reflection points was plotted in the approximation of geometrical optics. Differences between the reflection coefficients for each "beam" were disregarded, but the focusing effect was included. A comparison with experimental data taken in 1978 during 23-27 August and 14-17 September indicates close agreement with calculations based on the "three beam" mechanism of long-wave propagation during sunrise. Figures 4; references 9: 4 Russian, 5 Western.

USE OF SPHERICAL STANDARD REFLECTORS FOR CALIBRATION OF AMPLITUDE CHANNELS OF SYSTEMS FOR MEASURING THE SCATTERING MATRIX OF RADAR TARGETS

[Article by S.N. Polikarpov]

[Abstract] It is shown that use of spherical standard reflectors for calibration of systems for measuring a scattering matrix (SM) with coincident plane or circular polarizations requires consideration of the correlation of

amplitude characteristics of the transmitting or receiving channels of orthogonal polarizations, or those and others simultaneously, or acceptance of them in identical pairs. The best conditions during calibration of spherical standard reflectors are found in the case of equality of the modules of the elements of their scattering matrices. For this purpose the following combinations of the polarizations of the radiated and received signals are assumed: plane polarizations with a difference of orientation of the vectors of the radiated and received signals of 45°; circular polarizations of the radiated and plane polarizations of the received signals; or plane polarizations of the radiated and circular polarizations of the received signals; elliptical polarizations with a coefficient of ellipticity of $\sqrt{2} - 1$. References 5: 3 Russian, 2 Western.

FREQUENCY-PHASE SCANNING OF QUASI-OPTICAL FOCUSING SYSTEM

[Article by V.P. Tkachuk]

[Abstract] In 1984 and 1985 articles of which Tkachuk is, respectively, author and coauthor, the problem is considered of synthesizing a quasi-optical line forming a specified directivity diagram. The present article investigates the possibility of creating a system of such line-modules, with the object of focusing electromagnetic energy on a satisfactorily narrow area (collecting aperature). A sketch is shown of the geometry of the focusing system. Calculations of the distributed amplitude and phase of the excitation coefficients of each module are presented, and scanning using a rearrangement of the phases of these coefficients is investigated. The problem of focusing the field is formulated and solved and the results of phase and frequency scanning are presented. An algorithm of the synthesis of the focusing system is realized in Fortran language. Numerical calculations were conducted on an YeS-1060 computer for a system consisting of 15 modules. Thanks are given N.N. Voytovich and Yu.N. Kazantsev for a statement of the problem, constant attention to the work and helpful discussion of the results. Figures 3; references: 7 Russian.

ESTIMATION OF COMPLEX TARGET PARAMETERS BY MEANS OF SPACE-TIME TREATMENT OF SIGNALS

[Article by A.P. Trifonov and A.N. Lukin]

[Abstract] A correlation matrix is found for use in calculating the parameters of a target consisting of an assemblage of sparkling points or point radiations (with passive detection and ranging). The potential precision of evaluation of the maximum probability of the parameters of a complex target is investigated for the general case, including location of the target in the Fresnel zone of the receiving antenna and in the far zone. The following items are considered in detail: 1) Output signal of receiver of maximum probability; 2) Correlation matrix of evaluations; and 3) Estimation of distance and angular position of combination of two sources. The possibility of enhancing the precision of estimating the range of a complex source in relation to a point is experimentally confirmed. Figures 4; references 18: 16 Russian, 2 Western in Russian translation.

EXPERIMENTS WITH RESPECT TO REMOTE INVESTIGATIONS OF NATURAL RESOURCES IN THE MILLIMETER RANGE OF RADIOWAVES WITH USE OF SYNTHESIZED APERTURE PRINCIPLE

[Article by V.B. Shteynshleyger, G.S. Misezhnikov, and A.G. Selskiy]

[Abstract] During an investigation of natural resources by remote radio-physical methods, acquisition of a radio image of the earth's surface is often of interest. An experimental unit with a lateral field of view was created for this purpose. The unit employs the synthesized aperture principle in the millimeter range. Spread functions are shown, obtained as the result of optical treatment of radioholograms and photometric measurements of the image product of a corner reflector with an effective scattering cross section (ESCS) of 1 meter^2 installed in an arc. The width of the spread functions at a level of -3dB amounts to ~40 cm along the path line and ~70 cm along the slant range. Also established in the specific ESCS of the surface of a meadow which is equal to σ = -12dB with an angle of view of 45°. An image is shown of part of a forest, obtained after processing a radiohologram.

The detailedness of the image of the trees is in accordance with the width
of the spread function. Various types of woods are well defined by the image.
The experimental unit with the indicated parameters makes it possible to
determine with high reliability the specific composition of a wood and the
density, compactness, and nature of the top of individual trees. Figures 1;
references 7: 5 Russian, 2 Western.

CALCULATING JOULE LOSSES IN ELECTRODYNAMIC SYSTEMS WITH THIN OPEN METAL
SURFACES

[Article by A.S. Ilinskiy and G.Ya. Slepyan]

[Abstract] An impedance boundary condition is constructed with an impedance
of a special type suitable for calculation of losses in structures with thin
open surface conductors. The conditions are fulfilled for infinitely thin
surfaces, although thickness is included in the expression for the reactive
component of impedance. Diffraction of an E-polarized plane wave on a
periodic structure consisting of nonideally conducting half planes is
studied as a specific example. The major result of the work is an equation
for surface impedance which allows effective computation of thermal losses
in structures with thin open conducting shields. Figures 3; references:
8 Russian.

USE OF METHOD OF STANDARD EQUATIONS IN PROBLEM OF STATISTICAL MOMENTS OF A
SHORTWAVE FIELD PROPAGATING IN A MEDIUM WITH GAUSSIAN STRONG RANDOM
HETEROGENEITIES

[Article by V.N. Sekistov]

[Abstract] There is interest in a theoretical study of the statistical
characteristics of short waves propagating in media with gaussian strong

random heterogeneities. However, when relative fluctuations of dielectric permeability are great, present methods are not suitable. This work therefore develops an asymptotic method for computing these statistical moments of arbitrary order of the field, analogous to the known method of standard equations. References: 9 Russian.

6508/9835
CSO: 1860/261

DETERMINATION OF POSITION OF MOVING TARGET BY RADAR METHODS WITH USE OF WIDEBAND SIGNALS

[Article by G.S. Nakhmanson]

[Abstract] Use of wideband signals for detection and ranging of targets which move within the Fresnel region of the receiver antenna is considered, feasibility of such a radar system depending on the accuracy of its estimation of target coordinates and their derivatives. For the purpose of analysis, a target is assumed to move almost uniformly while being swept by the probing signal. The echo signal is assumed to enter the receiver antenna togetehr with a white Gaussian noise of known spectral density. The maximum-likelihood estimator of target coordinates and velocity components is the position of their vector corresponding to the absolute maximum of its mathematical expectation, such an estimator being unbiased in the case of reliable measurements, while the elements of the correlation matrix are inversely proportional to the determinants of corresponding elements in Fisher's signal information matrix. The technique is demonstrated on estimating the distance (radius-vector) and the radial velocity of a target as well as the dispersions of these estimates, using a square two-dimensional antenna array. The accuracy of the estimates, depending on the distance of the target, is determined by different relations than in a radar using narrow-band signals. Figures 4; references 11: 10 Russian, 1 Western in Russian translation.

2415/9835
CSO: 1860/296

USE OF VARIABLE-GAIN DISCRETE α-β AND α-β-γ FILTERS FOR TRACKING OBJECTS IN MOTION

[Article by S.N. Ponomarev and S.Ya. Zhuk]

[Abstract] A simple and very accurate method of tracking an object in motion is proposed which involves the use of variable-gain discrete α-β or α-β-γ Kalman filters. The quasi-optimum algorithm of filtration is based on the discrete equation of motion in distance or angular coordinates and the equation of measurements, with normalization of the state vector, assuming that a noncorrelated noise perturbs the initially continuous model of motion. The gain is calculated recurrently on each step. All filter characteristics are reducible to a dependence on one and the same parameter, namely the tracking index. The algorithm, shown here for these second-order and third-order filters, requires only one third the computer memory that constant-gain Kalman filter requires and almost as small a computer memory that a less accurate simple Wiener filter requires. The algorithm is readily extendable to higher-order filters. Figures 2; references 8: 5 Russian, 3 Western (2 in Russian translation).

2415/9835
CSO: 1860/296

ERRORS IN THE STATISTICAL ANALYSIS OF SIGNAL FADING IN TROPOSCATTER RADIO CHANNEL

[Article by V.G. Grigorev and V.A. Konkov]

[Abstract] This study solves the problem of minimizing the estimation error of the one-dimensional probability density by making the proper choice of the number and width of the differential analysis channels. Optimal, uniform, and combined methods for separating the dynamic range of the investigated signal into differential analysis channels are compared. The combined method, which is easily realized, increases the accuracy with which one-dimensional fading probability densities are estimated in a troposcatter channel. Figures 3; references 7: 5 Russian, 2 Western.

6900/9835
CSO: 1860/222

LIDAR DETERMINATION OF NUMBER OF PULSES

[Article by Yu.L. Koziratskiy, S.V. Potekhetskiy, and A.V. Smirnov]

[Abstract] The problem of LIDAR recognition of a target from its effective scattering area is addressed. The average number of LIDAR pulses needed to make a decision about the target type is determined using the Neumann-Pearson criterion and Wald's sequential analysis method. The average number of pulses is determined as a function of the recognition probability and confusion probability. The LIDAR algorithm employing Wald's analysis method is found to be more effective than Neumann-Pearson recognition for targets with different effective scattering areas. Tables 1; references: 5 Russian.

6900/9835
CSO: 1860/222

PERSONAL COMPUTER RADIO-86RK FOR RADIO AMATEURS

[Article by D. Gorshkov, G. Zelenko, Yu. Ozerov, and S. Popov, Moscow]

[Abstract] The radio amateur's microcomputer Radio-86RK includes a micro-processor (D6) on a KR580IK80A microcircuit chip. A special clock-pulse generator (D1) on a KR580GF24 microcircuit chip with a quartz oscillator setting the clock frequency at 16 MHz, 9 times higher than the microprocessor clock frequency of 1.78 MHz, also synchronizes the display monitor. The microprocessor synchronizing pulses are of 12 V amplitude, all other signals such as those for synchronization of peripheral LSI circuits are at the TTL level. The microcomputer includes also a memory or input/output selector with decoder, a read-only memory (D17), a dynamic direct-access memory (D22-29) on KR565RU3 microcircuit chips with multiplexing of addresses and with eight additional such chips available for expansion up to a 32 kbyte capacity, and a display monitor operating through this direct-access memory. A conventional televisor serves as display monitor, forming images on the screen by video signals with frame and line synchronization pulses applied to horizontal and vertical terminals respectively. Audio signals are formed unconventionally, with a time delay subroutine for input to the microtele-phone module and with realizability of various sound effects by a special subroutine built into the monitor. The article, begun in RADIO No 4, 1986, will continue. Figures 1.

2415/9835
CSO: 1860/300

PERSONAL COMPUTER RADIO-86RK FOR RADIO AMATEURS

[Article by D. Gorshkov, G. Zelenko, Yu. Ozerov, and S. Popov, Moscow]

[Abstract] The radio amateur's microcomputer Radio-86RK has a keyboard which encodes all symbols covering the scope of calculations, including letters of both Russian and Latin alphabets, in accordance with a table. All codes are stored in the read-only memory. An interlock prevents jamming and damage as well as contact jitter when two or more keys have been pressed simultaneously. Automatic follow-up provides continuous encoding and aural indication of contact closure when a key is pressed longer than 1 s. All components are mounted on printed-circuit boards. Thereis also an interface provided for hoodup to a magnetic sound recorder or other peripheral equipment. The microcomputer draws very little power: 0.3 A from a -5 V supply, 0.8 A from a +5 V supply, 150 mA from a +12 V supply. The compact power pack includes a 20-30 W transformer, a stabilitron, and a trimming resistor, with sufficient cooling surface and a laminated heat sink for theppower transistor. The article, begun in RADIO Nos 4-5, 1986, will continue. Figures 4.

2415/9835
CSO: 1860/304

INTERFERENCE ELIMINATION IN SERIES YUNOST TELEVISION SETS

[Article by S. Sotnikov, Moscow]

[Abstract] The sound track channel of Yunost-401/402/405/603 television sets contains series K2US248 or K224UR4 microcircuit chips, both series being schematically identical and consisting of an amplifier-limiter, and emitter-follower, and a 6.5 MHz difference-frequency output amplifier. The limiter generates many harmonics of the difference-frequency signal, especially large being the fifth and the sixth, which are enhanced not only by the matching frequency characteristics of both limiter and follower transistors but also by the automatic gain control. Resulting interference on the receiver screen is particularly disturbing during reception through a built-in telescopic antenna, in the form of wavy lines or fine meshes with an intensity depending on the modulation factor, also in a high-intensity field when the antenna is not completely pulled out. Eliminating this interference by additional shielding of the second-intermediate frequency (6.5 MHz) audio amplifier on the side of the printed-circuit board is not very effective, owing to proximity of the intermediate-frequency video amplifier. Much more effective is decreasing the bandwidth of the amplifier-limiter to 7 MHz by increasing the time constant of its load circuit to approximately 0.15 µs. This can be achieved by inserting a capacitor between its microcircuit and

the common wire so as to, in effect, increase the mounting capacitance till
this capacitance plus the amplifier-limiter output capacitance plus the
emitter-follower input capacitance becomes approximately 150 pF.
Figures 2.

2415/9835
CSO: 1860/300

USE OF SERIES K155 MICROCIRCUIT CHIPS

[Article by S. Alekseyev, Moscow]

[Abstract] The article, a continuation of earlier ones and to be followed
by more, reviews available series K155 microcircuit chips for various
applications. These include the K155IR1 sequential and parallel 4-digit
shift register with one controllable input, the K155IR13 reversible sequential
and parallel 8-digit shift register with two controllable inputs in addition
to one for clock pulses and one for 0 resetting of triggers, the K155TM8
storage with four D-triggers and with four inputs for data recording in
addition to joint two inputs for clock pulses and 0 resetting of triggers,
and the K155IYe9 synchronous parallel decade counter also usable either as
shift register for dynamic indication or in a variable-divisor divider.
Figures 8; references: 3 Russian.

2415/9835
CSO: 1860/300

USE OF SERIES K155 MICROCIRCUIT CHIPS

[Article by S. Alekseyev, Moscow]

[Abstract] The article, begun in RADIO No 5, 1986, continues a review of
available series K155 microcircuit chips for various applications. These
include logic gates AND (K155LI), OR (K155LL), NOT (K155LN), NOR (K155LYe),
NAND (K155LA), and AND-NOR (K155LR). There are standard gates (up to
N = 10 outputs), high-output gates (up to N = 30 outputs), special gates
with many more outputs in one of the logic states, and "high impedance" or
Z-state gates with a third output state in addition to 0 and 1. Other
microcircuit chips are K155LP8 and K155LP9 containing respectively four or
six followers with open collector (Z-state), K155LP7 containing two standard
NAND gates with a transistor in each, K155TL1 and K155TL3 with inverting
Schmidt triggers on NAND gates, and K155TL2 with inverting Schmidt triggers
on inverters. Conclusion of the article will follow. Figures 3; tables 1.

2415/9835
CSO: 1860/304

REVIEW OF MAJOR MOTION PICTURE ENGINEERING PROJECTS COMPLETED IN 1985

[Article by V.I. Omelin, N.S. Popov, V.V. Bolshunov, Yu.N. Grebeshkov, and A.G. Antoshechkin, Central Organizational Department of Scientific and Technical Information, Scientific Research Institute of Motion Pictures and Photography, V.M. Bondarchuk and P.V. Irz, Central Design Office of Cinematography, Ekran Scientific-Industrial Association]

[Abstract] Several engineering projects underway at the Ekran Central Design Office of Cinematography have been completed in 1985. In the film shooting department are ready for production the variable-focus objective 350PF29-1 for documentary films, replacing the earlier Foton, 350PF-9L, 350PF16-1 objectives, the superhigh-speed objective OKS5-22-1, the first variable-focus objective 350PFP for motion picture projectors, in two variants for front projection and rear projection respectively, the time-lapse motion picture projector A225A for 16 mm film, and the multipurpose work bench A543A. In the sound recording and reproduction department are ready for production the detonation meters 7E61 and 7E65 for quality control of tape transport mechanisms, and the special analog-digital limiter 60U531 for sound recording. This limiter was developed jointly with the Scientific Research Institute of Motion Pictures and Photography, where there also has been completed the design of automatic densitometric inspection of color films and film materials as a subsystem in the automatic control system for technological processes of film development and printing. This project included preparing an experimental prototype of measurement and recording set with a Makbet TD-504AM densitometer, a PL-80 tape punch, and an original universal densitometer-punch coupler, densitometer readings being recorded on tape in KOI-7 codes. Jointly with the State Institute of Motion Pictures Design, the Scientific Research Institute of Motion Pictures and Photography has put out an album of standard architectural acoustic components for outfitting movie production reference halls and movie theater auditoria. Continuation of the review is to follow. Figures 6; tables 2.

EFFICIENCY OF VIBRATION ISOLATION SYSTEMS FOR MOTION PICTURE CAMERAS

[Article by E.L. Vinogradova and M.Yu. Liberman, All-Union Scientific Research Institute of Motion Pictures and Photography]

[Abstract] The performance of vibration isolation systems for motion picture cameras is calculated in terms of acoustic impedances and the corresponding frequency characteristic. The efficiency of such a system is then obtained from the drop of vibration velocity from mounting plate to camera box in the form of a difference or a ratio. The applicable relations, in standard logarithmic notation, are expressed in easily measurable quantities so that the results of calculations can be correlated with experimental data for vibration isolation design. The procedure is demonstrated on vibration isolation for Soviet-made Kinor-35R, Konvas-avtomat cameras and foreign-made Eckler, Aaton cameras. The isolation efficiency is found to increase with increasing vibration frequency, up to a limit set by the stiffness of the camera box and the inertia of the elastic isolators. It therefore is expedient to maximize the impedance of the camera box, by using cylindrical or spherical segments and adding stiffener ribs. Figures 4; references: 13 Russian.

2415/9835
CSO: 1860/291

COLOR SEPARATION SYSTEMS IN OPTOMECHANICAL COMPONENTS OF THREE-TUBE COLOR TELEVISION CAMERAS

[Article by S.B. Byshkin, All-Union Scientific Research Institute of Television and Radio Broadcasting]

[Abstract] Color separation in three-tube color television cameras must be achieved without vignetting and without change in the modulation transfer ratio, an additional requirement being minimum camera size and weight. Use of dichroic mirrors with multilayer interference coatings ensures selective reflection, while distortion and shift of spectral characteristics can be minimized by low-angle incidence of the principal ray in the axial light beam and secondary spectral peaks can be suppressed by corrective filters. Three corrective filters, preferably interference filters than color-glass filters, are needed for a set of two dichroic mirrors. The advantage of using prisms is rigidity and consequently easy alignment, another one being high immunity to environmental effects. Their drawbacks are high absorption

losses and technological difficulties such as maintenance of tolerances on angular dimensions. Prisms are designed aberration-free and are assembled into a monoblock. Two dichroic mirrors can be combined with one prism, usually a large pentaprism, or with three or five prisms. The basis configurations are those where both mirrors face converging light beams and where both mirrors face parallel light beams. In the more intricate third configuration one mirror faces converging light beams and one mirror faces parallel light beams. Various designs are comparatively evaluated, use of glass with a high refractive index for prisms being considered as a size and weight reducing feature. The most favorable configurations are found to be parallel axes of light separation channels for minimum camera height and three prisms for minimum camera weight. Preferable is, moreover, extra-axial brightening of the mosaics in the transmitter tubes. Figures 10; references 28: 5 Russian, 23 Western (21 U.S. patents).

MINIATURE OPEN-TYPE HEADPHONES

[Article by Ya. Shch. Vakhitov, Leningrad Institute of Motion Picture Engineers, Ye.K. Gorbunova and T.L. Novikova, All-Union Scientific Research Institute of Radio Broadcast Reception and Acoustics]

[Abstract] In contrast to close-type headphones, which completely cover the ear in some fashion, open-type headphones do not form a closed cavity comprised of the headphone diaphragm, earpiece and ear canal. Open-type headphones allow a slot between the earpiece and the ear canal; this slot promotes free ventillation of the main headphone cavity and normal aural contact of the user with the environment. A design difficulty is that the slot must have a rather high mechanical impedance that does not fall off with decreasing frequency, so as to develop the requisite sound pressure in the cavity. The first condition is met by placing a porous insert in the slot, producing an acoustic impedance there independent of requency; the requisite velocity of the diaphragm is assured by opening up the back enclosure of the diaphragm with a small hole that couples the cavity under the diaphragm to the environment. This paper is a detailed mechanical and mathematical analysis (using both mechanical and electrical equivalent circuits) of such miniature headphone designs. The analytical techniques permit computer-aided design and optimization of the parameters of professional headphones. The example of the stereophonic TDS-14 headphones is discussed; when tested on an artificial ear, the frequency response varied no more than 18 dB between 20 Hz and 20 kHz, with the greatest fluctuations between 5 and 20 kHz. The plotted response is essentially flat between 125 and 3,000 Hz. A factor compromising design optimization of such headphones is the lack of clarity

in requirements placed on the shape of the frequency response obtained with
an artificial ear. Figures 8; references 8: 6 Russian, 2 Western.

MATHEMATICAL MODEL OF ADDITIVE FILM PRINTING PROCESS

[Article by E. Buresh, Ya. Eygl, Z. Sklenarzh and B. Shindelarzh,
Czechoslovakian SSR]

[Abstract] In an additive motion-picture film printing process, the actinic
exposure of the positive can be mathematically represented in terms of the
exposures of the three individual film layers; such an expression is written
in terms of the relative spectral response of the printing light, the
spectral transmittance of the light passing through the negative, the exposure
and the spectral sensitivity of the layers of the positive. The printing
light consists of the three B, G and R components, corresponding to the
individual channels of the additive illumination system of the film printer.
Each of the three component colors is modulated by a nonselective modulator
(independently of the wavelength). The expressions written for the exposures
of the individual layers of the positive are not amenable to direct measure-
ment. Quantitative analysis requires that the mathematical model of the
printing process be supplemented with a means of transforming the exposures
to measurable quantities: photometric values of the developed positive repre-
sented by the color separated optical densities. The primary response of a
layer to an exposure is the production of a latent image, then converted to a
color image by the processing. The three layers of the color positive in-
fluence each other, compromising the color discrimination of any analysis.
In order to circumvent this, the proposed additive printing model has three
steps: 1) The description of the formation of three latent, equalized,
color-separated images with their subsequent color developing (using the
method of least squares to determine the parameters of the characteristic
equation); 2) The description of the mutual influence of the layers; 3) The
measurement of the overall densities instead of the partial densities. The
model is checked using a set of negative images in 19 colors. The data from
the model calculations and the photographic experiment were expressed in the
same way in terms of the color separated densities for the corresponding copies
of the given negatives. The measure of agreement was based on A.H. Jones'
"just noticeable differenc" and one number is derived that represents the
average difference in the colors for the comparison of the two processes.
The good agreement between model and experiment shows that the former satis-
fies the conditions of compatibility and can be used to study the impact of

physical changes in the printing process on the final photometric and colorimetric quality of a copy, as well as take appropriate steps to assure exposure compatibility between various types of motion picture film printers. Figures 3; references 2: 1 Czechoslovakian, 1 Western.

8225/9835
CSO: 1860/216

CIRCUITS AND SYSTEMS

SYNTHESIZED NONLINEAR REACTIVE ELEMENTS AND THEIR APPLICATIONS

[Article by M.I. Bocharov and O.P. Novozhilov]

[Abstract] The following items are considered: 1) The construction principles and characteristics of synthesized nonlinear reactive elements (SNRE), a potential method for converting energy without loss, which as a result can be used during construction of the power units of electronic equipment, and 2) The synthesis of nonlinear reactive elements with a prescribed volt-coulomb characteristic (VCC). Some possibilities for the use of SNRE are listed. The small losses of power, the possibility of a change in the form of the VCC, and the accessibility of the component base are indicative of the outlook for the use of the proposed SNRE in the con- struction of the power units of electronic equipment. Figures 5; references: 3 Russian.

6415/9835
CSO: 1860/282

COMMUNICATIONS

WAYS TO ECONOMIZE NONFERROUS METALS FOR COMMUNICATION AND SIGNALIZATION-
CENTRALIZATION-INTERLOCKING CABLES

[Article by N.M. Burtsev, candidate of technical sciences, senior scientific
associate, K.A. Lyubimov, candidate of technical sciences, senior scientific
associate, B.N. Pushkarev, candidate of technical sciences, senior scientific
associate, and A.V. Sinelshchikov, engineer, All-Union Scientific Research
Institute of Railroad Transportation]

[Abstract] Existing underground cables and overhead transmission lines for
railroad communication and signalization-centralization-interlocking contain
approximately 86,000 tons copper, 40,000 tons aluminum, 25,000 tons lead, and
25,000 tons zinc. The expedient ways to improve the economy of these non-
ferrous metals are increasing not the capacity but the power of the trans-
mission systems, reducing the diameter of conductor strands, and modifying
the metal content. The trend is now to copper-aluminum cables rather than
to copper-steel cables for IKM-120 pulse-code-modulation equipment, MKPmEShp
4x2x1.05 high-frequency cables using 4.95-28 times less copper and 2.8 times
less aluminum than existing ones and TZPAShp 14x4-0.9 low-frequency cables
also saving zinc for galvanization. These cables have been developed by the
All-Union Scientific Research Institute of Railroad Transportation, jointly
with specialists at the Kuybyshev Cable Works for manufacture according to
the Kabelmetal (FRG) method. They require a nonmetallic water-repellant
filler and interference protection. Theoretical analysis as well as results
of electrical and mechanical tests indicate that copper cables should and
can be completely replaced with bimetal ones, upon appropriate modification
of soldering and splicing techniques. Tables 1.

2415/9835
CSO: 1860/267

DEVICE FOR INTERFACING YeS-1010 COMPUTER AND TAP-3S TRANSMITTER

[Article by O.L. Pevzner, chief, and V.Ya. Teleshevskaya, senior engineer, Computer Room, Main Computer Center, Ministry of Railroad Communication]

[Abstract] At the Main Computer Center for the Ministry of Railroads there is no interface linking the YeS-1010 computer to the TAP-3S telephone data transmitter so that the computer cannot also teleprocess data transmitted to it over switched telephone channels. A device is therefore proposed which will enable the computer to perform this function in a parallel code. The device is built on a standard processor card in the computer accessory file, to be inserted in any vacant space along the input-output bus of the central processor. It contains address 0007 for control of input data in register E and entering data in register A. It also contains instructions WRITE DATA and READ DATA, 6041 being its DVA interrupt control word and a STROBE signal transferring the device from the WAIT FOR DATA mode to the TRANSMIT DATA mode after a telephone connection has been established. Transmitter signals and interface signals are matched to correspond according to a signal identifier table. Insertion of the interface, with the contactors of its R24 relay modified for the READY signal from the computer, does not affect the performance of either computer or telephone data transmitter. Figures 3; tables 2.

2415/9835
CSO: 1860/267

NOISE IMMUNITY OF FM-SYSTEM OF RADIO COMMUNICATION WITH USE OF A FORM OF MULTIPLE-MODULATED SIGNALS

[Article by A.V. Markino]

[Abstract] A frequency modulated system is described in which receivers reproducing speech communications open only during the presence at their inputs of a carrier, modulated according to frequency by the corresponding communications. The noise immunity of the speech communication transmission channels is compared here with a noise sensitive single-channel FM system of radio communication. In calculating the noise immunity of a system with multiple-modulated signals it is considered that telegraph communication modulating the frequency of the repetition of a pulse subcarrier is absent. In the case of interaction of mobile objects with a stationary control point it is necessary to accomplish radio communication simultaneously with a small

number of channels, either with a change of distance or with transmission of narrow-band information, e.g., telegraphic communications. It is possible to solve this problem with the aid of multiple-modulated signals. Figures 2; references 4: 3 Russian, 1 Western.

MULTILEVEL CODE FOR DIGITAL TRANSMISSION SYSTEMS

[Article by D.G. Tunev]

[Abstract] An algorithm of converting a binary signal into a balanced 5-level code for digital transmission systems has been devised which ensures maximum utilization of the inherent redundancy in such a code for maximizing the repeater immunity to interference by intersymbol distortions with a minimum unbalance stroke, for extraction of the timing signal, for inspection of the line code without interruption of data flow, and for minimizing the error multiplication factor during decoding. The algorithm also simplifies both encoder and decoder structures. The algorithm can be used in double quaternary digital transmission systems with IKM-1920x2 pulse-code-modulation equipment and with repeaters up to 3 km apart. A short unbalance stroke, with the present digital sum in the encoder output signal changing from -3.5 to $+3.5$, and the structure of the conversions table ensure a high interference immunity of a repeater and a small error multiplication by the decoder. Figures 4; tables 6; references 9: 4 Russian, 5 Western.

DIGITAL LINE CHANNEL OF PRIMARY DIGITAL TRANSMISSION SYSTEMS FOR RURAL COMMUNICATION NETWORK

[Article by A.I. Milin, I.F. Zabelin, A.S. Prodan, and A.G. Mozel]

[Abstract] Equipment of the KLTS-2048 line channel, designed for two-way transmission of digital data flux at a rate of 2048 kbit/s over up to 50 km

long KSPP single-quad cables in rural communication networks, consists of
a BOLT-2048 terminal module and an SP-2048 intermediate station. The
terminal module, mounted indoors and suitable for operation at ambient
temperatures from +5°C to +40°C, operates in the pulse-polarity-alternation
or M-pulse-polarity-alternation mode of signal coding. Its basic six com-
ponents are a line-signal repeater and a station-signal repeater, a remote
line monitor with a generator of pseudorandom sequences, a local electric
power supply and accessories to a remote power supply, and a service communi-
cation set with indicator lights. The intermediate station is mounted outdoors
and is suitable for operation at ambient temperatures from -50°C to +55°C.
The intermediate station contains two line-signal repeaters, each consisting
of a corrector-computer with sloping automatic gain regulation, a cadence
synchronizer, a switchable output stage, and a power supply. It also contains
one remote line monitor which includes a detector of bipolarity distortions,
and analyzer of initial code combination, and a presettable counter with four
inputs. It is protected against dangerous pickup from electric power
transmission lines, electric railroads, and lightnings. It also contains
a service communication set. Figures 8; references: 11 Russian.

INTERCHAT CHANNEL EQUIPMENT IN INTERSPUTNIK SATELLITE COMMUNICATION SYSTEM

[Article by L.Ya. Kantor, V.M. Dorofeyev, V.I. Dyachkov, and V.V. Loginov
(Soviet Union), A. Barani, L. Uhereczky, T. Henk, and F. Rakosi (Hungary)]

[Abstract] The over 15 ground stations of the Intersputnik satellite communi-
cation system with an Atlantic region network and an Indian region network
contain Gradient N equipment, which provides multistation access to a
satellite based on frequency division of channels with frequency modulation
of individual carriers by telephone signals for stations handling small
traffic over few channels or based on time division of channels for stations
handling large traffic over many channels. Larger capacity and higher
stability as well as higher immunity to intermodulation interference is
offered by Interchat channel equipment recently put together within the
scope of the Soviet-Hungarian Interkosmos program, operating on the basis of
digital processing and transmission of speech signals. Both pulse code
modulation by phase keying with four phase positions and adaptive delta
modulation by relative phase keying with two phase positions are available
as alternate methods of analog-to-digital conversion at the transmitter
end, coherent demodulation of both kinds of modulated signals occurring at the
receiver end. The frequency range of signals is 52-88 MHz, the channel equip-
ment being coupled to the microwave transmitter and to the microwave receiver

in a ground station through 70+18 MHz interfaces. Only one frequency con-
version occurs on the transmitter side of the channel, by a frequency
synthesizer discretely tunable over the 116+18 MHz frequency range in
45 kHz or 80 kHz steps. Three frequency conversions occur on the receiver
side of the channel: first by a 111+18 MHz frequency synthesizer to 41 MHz,
then with a heterodyne to 5 MHz, and again to 512 kHz for filtering and
demodulation. In operation with carrier suppression, whether in the pulse-
code-modulation mode or in the adaptive-delta modulation mode, a preamble
signal is generated during pauses in speech. Figures 6; tables 1;
references 9: 3 Russian, 6 Western.

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MEASUREMENT OF DIFFERENTIAL DISTORTIONS IN IMAGE CHANNEL OF SATELLITE
TELEVISION SYSTEMS OPERATING WITH SIGNAL DISPERSION

[Article by L.S. Vilenchik, M.I. Krivosheyev, B.A. Lokshin, and Yu.D. Shavdiya]

[Abstract] The additionally modulating dispersion signal, introduced in a
satellite television system for improvement of immunity to electromagnetic
interference, causes nonlinear "differential gain" and "differential phase"
distortions in the image channel. Normalization and estimation of these
distortions on the basis of their maximum amplitude within a period of the
dispersion signal does not yield a subjective indicator of reception quality
and, at the same time, imposes costly constraints on the channel equipment.
It therefore is advisable to actually measure these distortions, most
expediently with a low-frequency (line frequency) ladder or sawtooth test
signal carrying a small-amplitude high-frequency (1.2 MHz) sinusoidal rider
signal. Nonlinear distortions of the luminance signal are determined from
the change in amplitude and phase of the rider signal while the luminance
changes from black level to white level. These measurements can be made
oscillographically or with digital instruments operating at a discretization
frequency of 25 Hz. The maximum value of a measured parameter during a
period of the dispersion signal should then be normalized, a more precise
determination of that maximum value being possible when the frequency of the
dispersion signal is equal to the line or frame frequency. Fairly precise
determination of its mean value is possible upon averaging of several readings.
Figures 3; references: 6 Russian.

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INSPECTION AND CONTROL OF ZONAL COMMUNICATION SYSTEM AND ITS PARAMETERS
OVER SERVICE CHANNELS

[Article by O.V. Golovin, V.Ye. Guzeyev, and V.N. Repinskiy]

[Abstract] A zonal radio communication system with remote radio relay is
considered, automation of which requires inspection of channels and measure-
ment of their parameters for the purpose of quality control. A comprehensive
automatic analyzer of channel quality, one in the adaptation stage of each
channel, contains a set of instrument transducers indicating the signal
level or field intensity, the signal-to-interference ratio, and the error
frequency, an analyzer of time distortions in demodulated binary signals,
and optionally also an analyzer of signal grouping. Channel quality can thus
be estimated either by means of redundant detection coding in a service
channel during data transmission over a main channel or by analysis of
time distortions in received information-carrying signals. The quality
control subsystem consists of such inspection modules for all channels and
a microprocessor, also a central special-purpose computer executing the
adaptation program for the remote radio relay. This subsystem yields in-
formation pertaining not only to the highest usable frequency and the lowest
usable frequency but also to propagation of signals and interference. A
prototype of this channel inspection module was built and tested at the
Moscow Institute of Electrical Communications Engineering. Its performance
was evaluated by measurements as well as by error probability and
correlation analysis. A service channel with this module has been organized,
transmitting inspection and control data at a rate one order of magnitude
lower than that of data transmission over a main communication channel and
thus with a correspondingly much higher reliability. Asynchronous cyclic
interrogation of service terminals from the radio relay is preferable to
more time consuming synchronous cyclic interrogation and to free access to
a main channel from all service terminals, which requires more frequency
channels than there are main channels. Asynchronous cyclic interrogation
minimizes the loss of time and the loss of calls in terms of probability,
especially in the case of several priority levels. Figures 4;
references: 6 Russian.

DEVELOPMENT OF ELECTRONICS IN CZECHOSLOVAKIA

[Article by Rudolf Shorm, candidate of technical sciences, director,
Scientific Research Institute of Communications Engineering imeni A.S. Popov,
Scientific-Industrial Association TESLA, Czechoslovakia]

[Abstract] The leader in the field of electronics in Czechoslovakia is the
TESLA Scientific-Industrial Association, whose Scientific Research Institute
of Communications Engineering imeni A.S. Popov together with partners in the
CSSR Academy of Sciences and other higher educational institutions has
ensured progress in five major areas. In the area of communication via
stationary satellites it has organized both television programming service
and radio programming service for professional, communal, and individual
reception. In the area of optical data transmission and processing it has
developed optoelectronic systems consisting of semiconductor devices, namely
semiconductor lasers and photodetectors, with fiber-optic transmission lines.
In the area of radio stations a new generation has been developed with
extensive use of CMOS and modular technologies for operation in the
450 MHz frequency band, these radio stations either to be installed in
permanent sites or to be transportable from site to site. Owing to the
modular concept of construction, same components are suitable for mobile
radio stations also being developed such as the MDR-82 operating in the
duplex mode in the 160 MHz frequency band or others operating in the 80 MHz
band. In the area of measuring instrumentation for use in microelectronics
several testers have been developed and are ready to be produced by various
enterprises such as ARITMA (Prague), ZPA (Koširže, Čakovice), BUMA (Nove
Mesto nad Vahem), and Computer Manufacturing Plant in Bnaska Bystrica.
These instruments include models MTS-10, MTS-20, and model TOA 1. Other
instruments for microelectronics are BM-578 characters analyzer and BM-583
logic analyzer supplementing programmers for memories and preprogrammed
memories to be produced by VUVT Zilina. In the area of microelectronics
TESLA enterprises are engaged, within the CEMA framework, in developments of
microprocessors and microcomputers including memories with extensive use of
bipolar as well as CMOS and NMOS devices, TTL and I^2L. Agreements with USSR,
GDR, and Polish enterprises ensure coordination and exchanges in development
and production of integrated-circuit chips as well as other passive and
active microelectronic components. It is noteworthy that the Czechoslovak
electronics industry promotes international cooperation but depends mostly on
its own resources, only 30% of all materials and parts being imported.
Figures 8.

DETERMINATION OF PARAMETERS OF COMPLEX SYSTEMS FROM AMBIGUOUS GIVEN DATA

[Article by Yu.V. Kryuchkov, V.Yu. Anisimov, and E.V. Borisov]

[Abstract] A method is proposed for designing a complex radio engineering system on the basis of ambiguous given data, namely sets of possible values. The method derives from the theory of imprecise sets and its application by the authors to determination of system characteristics as well as to solution of problems under indeterminate conditions. The design problem is defined in the form of inequalities and as solution is sought the vector of design parameters maximally certain to satisfy them. The method is demonstrated on determining the cost of a system from a linear combination of ambiguous data in the "approximately equal" class, such a combination belonging in the same class. The solution is analyzed for dependence of its reliability on the imprecision of the given data, which is done most conveniently with the aid of graphs representing relevant functional relations. Figures 2; references: 5 Russian.

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EFFICIENCY OF NONLINEAR ADAPTIVE SIGNAL PREDISTORTION

[Article by V.K. Maringodov, V.B. Novozhilov, and S.V. Ivashkov]

[Abstract] Optimal linear signal predistortion and postcorrection for higher interference immunity of message transmission can be improved by nonlinear adaptibe signal processing, namely adaptive companding for control of the dynamic range. The predistorted signal is compressed before entering the communication channel and expanded back after leaving it for subsequent correction. Feedback control of both compressor and expander is based on measurement of the dynamic range by an analyzer. A spectrum analyzer at the receiver output monitors the channel response to signal compression, but the channel performance doesnot depend appreciably on the feedback lag time nor on the predistorting filter and postcorrecting filter adaptation times. The efficiency of such a message transmission system, calculated for signals typically appearing with white additive Gaussian noise in the main information channel, is adequate in terms of much lower ε-entropy in the feedback channel.

This is demonstrated in the simple case of a signal with a uniform spectrum after predistortion. Figures 1; references: 5 Russian.

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COST EFFECTIVENESS OF TECHNICAL MAINTENANCE OF RADIO EQUIPMENT FOR OPERATIONS CONTROL

[Article by A.I. Itsikson, scientific associate, All-Union Scientific Research Institute of Railroad Transportation]

[Abstract] Technical maintenance of radio equipment for railroad operations control is analyzed from the economic standpoint. Three possible strategies of replacement are considered, namely on a contingency basis and on a preventive basis without or with change in timing after replacement necessitated by failure. The cost effectiveness of all three strategies is evaluated comparatively in terms of a break-even which accounts for mean time and mean cost of replacement operation as well as for mean cost of shutdown. This indicator, together with known mean failure rate and mean time between failures, yields the necessary periodicity of preferable preventive maintenance. This strategy is further refined by grouping of equipment on the basis of life expectancy and safety margins for most cost effective multiperiodic multiparametric maintenance. Figures 2; tables 2.

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RELIABILITY OF BRASS PARTS IN SIGNALIZATION-CENTRALIZATION-INTERLOCKING EQUIPMENT

[Article by A.Ye. Mironov, junior scientific associate, All-Union Scientific Research Institute of Railroad Transportation Engineers, and R.Sh. Yagudin, head, Department of Centralization, Signalization, and Communication Reliability, Main Administration of Signalization and Communication, USSR Ministry of Railroads]

[Abstract] The reliability of signalization-centralization-interlocking equipment, on which railroad traffic safety depends, is largely determined

by parts made of brass and contact bolts especially. Three grades of brass available for contact bolts have been compared with regard to their metallurgical, mechanical, and electrical characteristics. The data indicate that grade LZn32 with better electrical properties is more suitable for cold forming and less prone to intergranular corrosion but mechanically weaker than grades LZn37 and LZn40S. Bolts now made of grade LZn37 at the Kaluzha Electrical Manufacturing Plant are annealed at 270-300°C and thus below the recrystallization temperature (350°C), which does not provide full relief of internal stresses and thus contributes to faster corrosion fatigue. A higher corrosion resistance can be achieved by replacing brass with bronze or with brass containing less zonc, by annealing at 400-240°C for full relief of internal stresses, and by increasing the radius of transition from bolt head to bolt thread. An analysis of data on bolt failures of PPR3-5000 relays and ST-5 transformers in the Moscow Metropolitan subway system indicates that replacing grade LZn37 with grade LZn32 brass would be adequate and expedient, with the radius of transition between head and thread increased to 2 mm, and with the bolts annealed at 470-500°C for maximum mechanical strength. Tables 2.

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AUTOMATED COMMUNICATION NETWORK IN LITHUANIAN SSR

Moscow ELEKTROSVYAZ in Russian No 6, Jan 86 pp 3-9

[Article by A.A. Vaysa, deputy minister of communications, Lithuanian SSR]

[Abstract] A detailed description, illustrated by 12 figures, is given of the automated communication network established by Lithuania in accordance with the plan for development of communication networks. The automated network includes a complex of technical means by which problems of the combined operation of communication equipment and apparatus created earlier and in recent years are solved. (The various units involved are listed.) The principal problems being solved by the complex include: better satisfaction of the requirements of the population and the economy in electrical communication services, assurance of network reliability, complete automation of telephone and telegraph communication, as well as data transmission on a base of electronic and quasielectronic switching systems, organization on the same cable lines of two interchangeable networks based on analog and digital transmission systems, and creation of an automated control system for the communication network of the Republic with the use of computing techniques. Figures 12.

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SYSTEM APPROACH TO DESIGN ORGANIZATION OF RADIO RELAY LINE-OF-SIGHT LINES

[Article by V.K. Ashirov, Ye.D. Pankratov, and A.I. Rakov]

[Abstract] An analysis is made of 10 published articles (mainly from ELEKTROSVYAZ) concerned with design optimization of radio relay lines (RRL). It is possible to divide these articles into two groups: 1) Problems of the strategy of the construction of RRL equipment, and the choice of optimum power parameters for the equipment; and 2) Problems concerned with the optimum construction of RRL (choice of route, height of antenna supports, etc.) with prescribed parameters of the equipment. Problems which pertain to the means of optimization discussed in the works of the second group are considered. An overall solution of the problem of design optimization of a RRL is proposed on the basis of an approach which takes into account all the technical-economic indices (TEI), the development of a system of inter-correlated models for determination of TEI, and an overall model of optimization. Figures 1; references: 10 Russian.

AUTOMATED PRODUCTION LINE FOR DESIGN OF RADIO RELAY LINE-OF-SIGHT LINES

[Article by I.A. Zhosan, A.A. Kozhinskiy, and A.Yu. Lapidus]

[Abstract] One of the most important problems which arise during development of projects for construction or reconstruction of radio relay line-of-sight lines is calculation of the route. In recent years computers have been used to solve this problem. However, even taking into consideration the increasing necessity to computerize planning, it is advisable to consider the complex problem in question and methods for its solution. Over a number of years the State All-Union Planning Institute (GSPI) developed a version of a programmed complex, the possibilities of which were developed one after another. The complex created, "Automated Production Line For Design of Radio Relay Line-Of-Sight Lines" (APLD RRL), makes it possible: 1) To check and store initial and standard data for calculation of RRL; 2) To determine the optimum height of the support and the height of the antenna suspension; and 3) To calculate the performance figures of the RRL. Two operating condi-tions of the APLD are considered - without optimization and with optimization

of the height of the support. An algorithm for optimization of the height of the antenna suspension, and the effectiveness of use of the APLD RRL are described. Figures 2; references 3: 2 Russian, 1 Western.

DISTINCTIVE DESIGN FEATURES OF MINIATURE SINGLE-BAND MICROWAVE MODULATORS

[Article by V.I. Gvozdev, M.Yu. Litvinenko, and V.B. Sedletskiy]

[Abstract] The object of this article is an analysis of the structure of the single-band modulator described by Ye.M. Vorobyevskiy, V.I. Gvosdev, M.Yu. Litvinenko, and A.M. Chernushenko in "Broadband Balance Microwave Modulators" [ELEKTRONNAYA TEKHNIKA. SER. ELEKTRONIKA SVCh, 1984, Vyp. 9 (369)], which reveals the maximum possible electrical characteristics in the frequency band: loss of conversion in one band L_{om} and suppression of the other sideband N_{om}. Modelling of a single-band modulator in the frequency region made it possible to obtain the analytical dependences of the basic electrical characteristics from the parameters of an equivalent circuit and to optimize the structure of the device with respect to the criterion: maximality of the operating frequency band with minimum losses. The optimum structure of the single-band modulator can only be realized in the form of microwave bulk-effect integrated circuits. The satisfactory agreement of the theoretical results with experiment bears witness to the accuracy of such an approach to the single-band modulator considered, in the long-wave range. The model presented can be used in larger high-frequency ranges, but for an adequate description of it, development is necessary of an electrodynamic model requiring complex calculations and the use of numerical methods. The derived relations can serve as initial approximations in calculating procedures. Figures 4; references: 7 Russian.

DESIGN AND REALIZATION OF PRECISION MONOLITHIC QUARTZ FILTERS

[Article by D.A. Borovinskaya, G.A. Nilova, and I.N. Yukhno]

[Abstract] Along with problems of a technological nature connected with the production of precision monolithic quartz filters (MQF), the problem arises of determining the parameters of the equivalent replacement circuit of these filters. In a number of cases approximation methods are sufficient for the design of precision MQF. A more precise method developed for design of multiresonator, monolithic filters made it possible to determine the parameters of the model of a ten-resonant filters, the characteristics of which satisfy the requirements for the filters of the individual channels of similar transmission systems. An algorithm is proposed which assures obtaining the necessary characteristics, is sufficiently simple, and makes it possible to automate the technology of manufacturing MQF. As the result of the nonregular nature of the remaining nonuniformity of the characteristics of the filters in the transmission band, it is advisable to evaluate them with respect to the results of the averaged characteristics, which makes it possible substantially to increase the coefficient of the output of servicable products and accordingly to reduce the cost. Figures 3; references: 5 Russian.

ORGANIZATION AT LENINGRAD ELECTROTECHNICAL INSTITUTE OF COMMUNICATIONS IMENI M.A. BONCH-BRUYEVICH (LEIS) OF TEACHING COURSE FOR THOROUGH PREPARATION IN THE FIELD OF FIBER-OPTICAL TRANSMISSION SYSTEMS

[Article by M.M. Butusov and V.N. Gomzin]

[Abstract] The organization at LEIS of a course for preparation in the field of fiber-optic transmission systems is described. The course includes lectures, seminar and laboratory studies, prediploma practice and diploma planning. The program takes into account the value to the students of such previous courses as "General Physics," "Technical Electrodynamics," "Theory of Signal Transmission," "Communication Lines," and "Electronic and Quantum Microwave Devices." Studies include the structure and construction principles of multichannel digital and analog transmission systems as well as questions of planning, production, and use of systems and their basic components:

semiconductor lasers and light-emitting diodes, photodetectors, optical fibers and cables, optoelectronic modules, optical connectors, etc. The lecture course contains the following basic divisions: structure of lightguide (optical) systems for information transmission (OITS); light propagation in planar and fiber lightguides; components of OITS; methods for their production and equipment; fiber-optical lines and systems and their application. The Department for Optical Systems of Information Transmission (established in 1982) in order to monitor mastery of the lecture material, developed a program for the micro-computer Elektronika D3-28 which makes it possible for the students in dialogue mode to evaluate the level of their knowledge. A laboratory course organized by the department is also described.

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INTEGRATED TELEGRAPH QUALITY CONTROL SYSTEM

[Article by P.F. Koluseva, chief engineer, Kurgan Telegraph Office]

[Abstract] An integrated telegraph quality control system put in place at the Kurgan Telegraph Office in 1982 is described. The system is based on 31 standards that are set for all basic technological processes, including the interaction between different structural subdivisions, material incentive programs for workers, socialist competition, etc. Operating indicators before and after the implementation of the system are compared, showing a significant improvement. The quality control system ensures objectivity and comparability of the assessments of the operating performance of the organization while increasing the responsibility of the supervisors at all levels for the accuracy of reporting data.

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EFFECT OF MICROCOMPUTERS IN COMMUNICATIONS SYSTEMS

[Article by V.N. Vasilenko, chief, Engineering Department, Voronezh Production-Engineering Communications Administration]

[Abstract] This article describes an Elektronika-60 microcomputer-based stored-program complex for recording orders for scheduled long-distance calls and supporting the 09 information service in municipal telephone networks. The operator position is outfitted with a keyboard and a plasma display capable of displaying 16 characters simultaneously. The procedure by which the operator enters call orders is described. The new system, which has been in operation at Voronezh for over a year, has prevented the acceptance of orders for more calls than could be handled, and has ensured accurate call scheduling. Call recording time has been reduced from 160-180 sec to 15-20 sec, with annual savings of 34,000 rubles. In serving information calls, the system has reduced the number look-up time to less than 3 seconds, providing an annual savings of 22,000 rubles. Plans call for adding two more automated subsystems to the municipal telephone system control complex: One for keeping track of workers' letters, complaints, and requests, and one for keeping track of telephone installation and main-line and distribution cable loading.

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COMPONENTS, HYBRIDS AND MANUFACTURING TECHNOLOGY

SPECIAL-PURPOSE WORK BENCH SRM-01 FOR ASSEMBLY OF PRINTED-CIRCUIT BOARDS

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 86 p 63

[Article by O.S. Permovskiy, engineer, V.S. Zagalskiy, engineer, and
V.T. Bugayev, engineer, All-Union Scientific Research Institute of Electric
Welding Equipment]

[Abstract] A special-purpose work bench has been designed and built for
high-productivity manual assembly of printed-circuit boards by semiskilled
labor. It consists of three modules, two on the table and one underneath.
Boards are mounted in a frame with luminous place and polarity indication
for electronic components. The latter are kept in and fed from a 5-tier
parts box with nine drawers on each tier, mounted on a vertical shaft.
Drawers on trays rigidly coupled to a friction clutch can slide out and in,
while the shaft driven by two RD-09 motors can turn the tiers back and forth.
The third module containing a power supply and controls for the feed mechanism
as well as for the indicator panel is mounted under the table with a pedal
switch on the floor. The work bench costs 2,000 rubles. It reduces production
costs by about 15,000 rubles/yr at the Leningrad Elektrik Plant imeni N.M.
N.M. Shvernik, about 8,000 rubles/yr at the Vilnyus Electric Welding-
Equipment Manufacturing Plant, and about 6,000 rubles/yr at the Utena
Laboratory Electric-Furnace Manufacturing Plant. Figures 1.

2415/9835
CSO: 1860/294

COMPUTERS

PROGRAMMABLE MICROCALCULATORS BUILT WITH SERIES K145 (K745) LARGE-SCALE-
INTEGRATION CHIPS

[Article by V.P. Zakharov, Yu.M. Polskiy, and N.P. Romashko]

[Abstract] A new family of programmable microcalculators, successors to the
Elektronika BZ-21, has been developed using series K145 (K745) LSI chips.
All three models, Elektronika BZ-34 as well as Elektronika MK-54 and
Elektronika MK-56, operate sequentially. Each contains at least four single-
chip microcomputers with internal read-only memory and one direct-access
register memory. They process data in the decimal system with floating
point. In the programming mode operations and instructions are coded and
entered in the program memory whereupon the programs are scanned and edited
prior to execution. Automatic execution of operations, programming, and
execution of programs are facilitated by the microcomputer which controls
the sequential computation system. Incorrect operation or program execution
as well as overflow stops the process with an attendant ERROR indication.
Write-in of calculations, including calculation of trigonometric functions
of angles given in degrees or radians, is performed by another microcomputer.
The model Elektronika MK-61 microcalculator of this family will contain an
additional single-chip microcomputer for extended automation of extra
purposes. Figures 1; references: 1 Russian.

2415/9835
CSO: 1860/296

CONTROL OF RESTORATION OF FUNCTION IN REDUNDANT MICROPROCESSOR SYSTEMS

[Article by A.G. Aleksenko, A.S. Bzhezinskiy, M.S. Kupriyanov, and O.N. Yarygin]

[Abstract] A new approach is presented to the creation of methods for control of restoration of function of redundant microprocessor systems, based on a mathematical apparatus suggested in a French work entitled "Introduction to the Theory of Undecipherable Sets." Primary attention is given to monitoring the reserve of microprocessors for failures. The method is based on the assumption that information on system failures is undecipherable. Information indicating a failure cannot unambiguously indicate the location of the defect. The presence of uncertainty is considered in the mathematical apparatus describing operation of the fault-tolerant system. A reconfiguration model is generated oriented not only toward catastrophic failures, but also simple faults. The sensitivity of the model to faults is regulated by changing the degree of tolerance, an increase in which causes the system to stop reacting to rare fault events, allowing reconfiguration, at the limit, only following catastrophic failures. The specific value of the degree of fault tolerance is determined by the purpose of this system. Figures 1; references: 5 Russian.

ELECTRICAL INSULATION

COMPARATIVE EVALUATION OF THERMAL STABILITY OF POLYURETHANE COMPOUNDS

[Article by I.I. Kravtseva, engineer, V.A. Silantyev, engineer,
L.N. Yamshchikova, engineer, T.P. Starostina, engineer, V.N. Kornyukhina,
engineer, Ye.Ya. Yeroshina, engineer, and T.S. Bebchuk, engineer]

[Abstract] A study of polyurethane compounds VILAD-13-1 and VILAD-14 was
made, for the purpose of evaluating and comparing their thermal character-
istics as well as the effect of modification on the dielectric properties
during slow aging. Both compounds consist of polyol (component A) and
polyisocyanate (component B) liquid at room temperature, each compound
using a different polyol. Furthermore, compound VILAD-13-1 was also
modified by addition of 25% ED-22 epoxy to component A. Specimens of all
three compounds were heated to 600°C at a rate of 5°C/min. In the process
were recorded loss of mass, rate of loss, and thermal effects. Thermo-
gravimetric and differential thermogravimentric data indicate that VILAD-14
has the highest temperatures of maximum mass loss, of maximum decomposition
rate, and of exothermic peaks. Electrical measurements revealed an increase
of the dielectric loss tangent and a decrease of the electrical resistivity
with rising temperature. The breakdown criterion was reached at all aging
temperatures. Statistical evaluation of the results indicates that VILAD-14
remains most stable during aging and that addition of epoxy increases the
stability of VILAD-13-1. After aging, moreover, VILAD had lost almost all
of its tensile strength and had become completely plastic, its breakdown
voltage having dropped to below one half. Meanwhile, VILAD-13-1 + ED-22
and VILAD-14 had lost only some elasticity without loss of tensile
strength, that of VILAD-14 having even increased somewhat, and their break-
down voltage had dropped much less. Figures 3; tables 2; references:
2 Russian.

ELECTRON DEVICES

SANDWICH PAIRS OF JOSEPHSON JUNCTIONS

[Article by L.E. Amatuni, V.P. Koshelets, G.A. Ovsyannikov, and
I.L. Serpuchenko, Institute of Radio Engineering and Electronics, USSR
Academy of Sciences, Moscow]

[Abstract] An experimental study of Josephson junctions in sandwich pairs
with direct conduction was made, for the purpose of determining their
electrophysical properties and microwave-frequency characteristics.
Specimens of superconductor structures on the basis of Nb films were pro-
duced by involvement of three spray deposition methods (high-frequency,
magnetron, electron-beam) and photolithographic patterning. Such a
structure on a Si substrate consisted of a thin Al_2O_3 layer, a 2200 Å
thick Nb electrode layer with a 1000 Å thick Ag resistive shunting channel
and a SiO window, a 2700 Å thick SiO insulation layer, a 40-70 Å thick Si
interlayer, and a 3000 Å thick other Nb electrode layer. The superconductor
characteristics of individual junctions were measured at a temperature of
4.2 K. Their current-voltage characteristics and those of sandwich pairs
without a microwave field and in microwave fields at 1.7, 10, 42 GHz fre-
quencies were measured at temperatures from 2 K up to the critical temperature
9 K for Nb films. The results reveal nonhysteretic current-voltage character-
istics of individual junctions and of sandwiches, also generally better
microwave-frequency characteristics of sandwiches than those of weak-link
structures with soft materials. The authors thank A.N. Vystavkin and
V.N. Gubankov for interest, also S.A. Kovtonyuk for helpful discussions.
Figures 7; tables 1; references 12: 8 Russian, 4 Western.

SHAPER OF SHORT PULSES BASED ON INTEGRATED CIRCUITS

[Article by V.P. Bakalinskiy and V.D. Bichukov]

[Abstract] The circuit is presented of a shaper of pulses at various
outputs at the front, at the droop, as well as at the front and droop of an
output pulse. The method of operation of the shaper, and laboratory tests of
it are described. The device is achieved with Series 564 integrated circuits.
Figures 4; references 4: 3 Russian, 1 in Russian translation.

INSTRUMENTATION AND MEASUREMENTS

DIGITAL CORRECTION OF AIRCRAFT FUEL MEASUREMENT SYSTEM READINGS

[Article by A.L. Alimov, Leningrad]

[Abstract] From 50 to 60% of the measurement error in aircraft fuel quantity measurement systems is due to changes in fuel position in the tanks during aircraft maneuvers. Such errors are systematic and a function of the volume of the fuel, V, in the tank and the vector, n, perpendicular to the fuel surface, assumed to be a plane. Digital correction of such errors is possible through compression and compact storage of fuel metering system data. The compression factor for feasible data compression algorithms needed for the correction of measurement system readings falls in a range of 2 to 30 and is a function of the properties of the initial family of functions of V and n, and the grid size chosen for the digitization of the variables V and n. Minimizing the memory size leads to the partitioning of some special graph into the minimum possible number of complete subgraphs; a heuristic algorithm is proposed for this. The theoretical treatment adduces neither sample calculations nor specific design examples. References: 3 Russian.

8225/9835
CSO: 1860/242

TRANSDUCER OF SPATIAL SHIFTS WITH INCREASED RESOLUTION

[Article by S.L. Titov, Vinnitskiy Polytechnical Institute]

[Abstract] A method is proposed, which in the case of transducers of linear and angular shifts operating according to the sequential calculating

method, makes it possible without alteration of the master system to increase significantly the precision of conversion. This is achieved by an increase of the number of sensors, information from which is taken by the read-out method in the Johnson code, and which forms minor classes of data at the output of the converter. The device is made with series 155 integrated circuits. A detailed explanation is given of: (1) The block diagram of a transducer constructed in accordance with a combined method of conversion; and (2) A basic diagram of the logical part of a transducer operating in a device with a binary-decimal number system.

6415/9835
CSO: 1860/307

MULTIPURPOSE INFORMATION-MEASURING SYSTEM FOR REMOTE DIAGNOSIS OF THE PARAMETERS OF MATERIALS AND MEDIA BY AN OPTICAL METHOD

[Article by V.I. Ivanov, I.A. Malevich, M.V. Svintilov, and V.I. Pranovich, Scientific Research Institute for Applied Physical Problems, Laboratory of Analog-Digital Methods of Measurement, Minsk]

[Abstract] The multipurpose information-measuring system described in general terms is intended for investigation of the parameters of materials, liquids, and gaseous media by an optical method based on the effects of aerosol, molecular, a combinative and gigantic combination of scattering, polarization, luminescence, absorption, and others. The system can be used for an investigation of the optical characteristics and the composition of the atmosphere and oceans, distance measurement, investigation of the processes of interaction and propagation of optical radiation in various media, diagnosis of the parameters of mulitcomponent mixtures, semiconductor structures, etc. The system is part of a diagnostic complex of equipment and is used in combination with a transceiver of optical radiation, consisting of a source of sounding radiation (laser), a spectral selection device fulfilled on the base of a MDR-23 monochromator, a calcite polarizer, a collection of interference filters, and a photodetector block. Depending on the problem, the system can operate with various type of lasers and photodetectors, including the pulsed and continuous lasers LTI-701, LZhI-401, LGI-505, LTN-402, photomultipliers FEU-83, FEU-128, FEU-130, FEU-147, photomultipliers based on microchannel plates, semiconductor photodetectors, including also the multielement photodetectors MF-14, K1200TsL1, and K1200 TsM1. The system can operate both in a regime of direct energy photodetection of input signals and in a regime of heterodyned reception, and to process light signals from the level of individual photons up to the level of strong current signals, including also the multiphoton transition zone. The weakly intense signals are separated from noise by the multiple digital accomulation method. The basic data for the system are presented.

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EXPERIMENTAL INVESTIGATION OF MICROSTRIP DEVICES BASED ON NEW STRUCTURES

[Article by I.I. Drobyshev, V.P. Meshchanov, I.N. Saliy, S.A. Saliy, I.A. Tsota, and L.V. Shikova]

[Abstract] The results are presented of an experimental investigation of two microstrip devices: wave impedance transformers and a band-pass filter, built on the basis of new structures. Their constructional parameters are shown. It is impossible to extend the results obtained to other frequency ranges and to other devices without conducting additional investigations. Nevertheless, the results confirm the generality and effectiveness of the approach to problems of synthesizing coaxial, strip, and microstrip devices on the basis of a T-approach. This generality lies in the fact that it is possible in a number of cases to use the T-model as a unique and sufficiently precise model of a projected device, and in the majority of cases as the most favorable first approximation in optimization procedures intended for a higher level model. Figures 2; references: 8 Russian.

DETERMINATION OF THE PARAMETERS OF MICROSTRIP STRUCTURES ON THE BASIS OF ITERATION METHOD

[Article by Yu.N. Novikov and A.V. Chepurnov]

[Abstract] A method for calculating the parameters of microstrip structures consisting of an arbitrary number of parallel strip conductors is described.

In the general case it is assumed that the conductors can be located both within the dielectric layer and on its surface. An iteration approach is used to determine these parameters in a quasi-statistical approximation based on the method of minimum discrepancies, and the use of Gaussian-type quadrature formulas for solution of integral equations of the first class. A simple estimate of the error of calculation of Green's function is obtained, presented in a series of logarithmic functions. A detailed description of an algorithm is presented. The authors express their sincere gratitude to M.I. Kontorovich for assistance in the work and for constant attention, as well as their thanks to V.N. Dikogo for helpful discussion and recommendations. Figures 2; references 8: 7 Russian, 1 Western.

6415/9835
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AMPLIFICATION OF SHORT PULSES IN TRAVELING-WAVE TUBES

[Article by I.A. Nankin and V.G. Shkolnikov]

[Abstract] The energy characteristics of traveling-wave tubes during amplification of short pulses, the duration of which is less than the transit time of electrons through the system, are investigated on the basis of numerical modeling on a computer with the use of nonlinear nonstationary theory. During such amplification, a large number of physical effects occur, different from the case in a monochromatic signal amplification. The principal ones are included in the following: 1) Strong dependence of the effectivenexs of interaction on the polarity of video pulses; 2) Significant amplification of power in the pulse as compared with the power of a monochromatic signals; and 3) The maximum effectiveness of interaction results with negative polarity of the video pulse. In the process of amplification only slowed electrons are generated with complete absence in space of the interaction of accelerated particles. In connection with 2), this effect is connected with the energy of electrons stored in a short pulse, nonlinearly interacting with it in the course of a sufficiently large interval of time. The effect described evidently bears a sufficiently general nature and is connected in the main with nonlinear processes. Figures 5; references: 8 Russian (1 concerned with foreign electronics).

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FREQUENCY CONVERSION IN KLYSTRON-TYPE DEVICE

[Article by L.V. Rodygin and A.V. Smorgonskiy]

[Abstract] The laws governing the bunching process in a klystron-type
device are analyzed. In the device individual sections of the electron flow
contract under the effect of a voltage which increases in time. The basic
laws of the bunching process in such a device, as in the theory of an
ordinary klystron can be described within the framework of a one-dimensional
model of a beam, disregarding the action of the space charge forces, if the
speed of the particles in all sections of the beam are assumed to be
identical and unchanged in the drift process. Conversion to a periodic
regime as well as a quantitative evaluation of the possibilities of the
device are considered. It is stressed that the nature of the dependences
involved can substantially change in the range of relativistic ($U_O > U_e$)
energies of the particles. Figures 3; references: 10 Russian.

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CONCERNING REMOTE DIAGNOSIS OF VIBRATING OBJECTS IN MM-BAND

[Article by E.I. Gelfer, N.S. Stenanov, and S.Ye. Finkelshteyn]

[Abstract] Estimates are made and the results are presented of experiments
concerned with measurement by radar ($\lambda = 8$ mm) of the frequency and ampli-
tude of the harmonic oscillations of model objects in the form of flexible
metal plates. A spectral analysis is conducted for the more complex signals,
obtained during vibration of the models and certain real objects. A block
diagram of the experimental equipment and the spectra from various objects
including the GAZ-53A automobile are shown. Figures 3; references:
5 Russian.

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EXCITATION OF SURFACE WAVES AT A PLASMA-METAL BOUNDARY BY ELECTRON BEAMS

[Article by N.A. Azarenkov and V.V. Kostenko]

[Abstract] A study is made of the excitation of surface waves propagating
along a metal-semiinfinite plasma boundary by monoenergetic electron beams
of low density. The system is placed in an external magnetic field such
that the electron cyclotron frequency is between the undisturbed electron
density in the beam and the plasma. The coordinate system is selected so
that the beam moves in the direction of propagation of the wave, which is
perpendicular to the plasma-metal division boundary. References: 3 Russian.

6508/9835
CSO: 1860/261

FOCUSSING SURFACE MAGNETOSTATIC WAVE CONVERTER

[Article by A.V. Bashkovskiy, K.V. Grechushkin, A.V. Stalmakhov and
V.A. Tyulyukin]

[Abstract] A theoretical and experimental study is presented of the
propagation of surface magnetostatic waves excited by a curved microstrip
transducer. The possibility is demonstrated of focussing the magnetostatic
waves by proper selection of microstrip curvature. It is assumed that the
dimensions of the microstrip converter are significantly less than the
wave length in free space and much greater than the length of the surface
magnetostatic wave. Theoretical and experimental results agree well.
Figures 2; references 4: 3 Russian, 1 Western.

6508/9835
CSO: 1860/261

GENERATION OF SUBNANOSECOND HIGH-CURRENT PULSES BY MEANS OF AVALANCHE-
SWITCHING DIODES

[Article by V.N. Legkiy and I.D. Mitsenko, Novosibirsk Institute of
Electrical Engineering]

[Abstract] A generator of ultrashort current pulses using a silicon
avalanche-switching diode with n^+-n-p-p^+ structure was studied experimentally,
generation of subnanosecond current pulses of over 1 A amplitude being
theoretically feasible owing to fast propagation of the impact ionization
front and fast plasma capture within 10^{-10} s. Pumping voltage pulses of
higher than 100 V amplitude and approximately 100 ns duration were generated
at repetition rates up to 4 kHz by a 2T926A transistor switch with a
saturable-core pulse transformer and applied to a VD1 avalanche-switching
diode through an LC filter. The current pulses in a low-resistance load
were recorded by a high-speed oscillograph with 1200 MHz bandwidth and
0.3 ns transient time. A current pulse was found to begin with a linear
rise to 0.5 A till breakdown and then oscillate reaching an amplitude up
to 20 A, depending on the load (strip line) resistance, within 10-20 ns.
It was thus found to include a pedestal of about 1.2 ns duration and a peak
of less than 014 ns duration. The pulse power remained almost constant as
the load resistance was varied over the 0.25-5 ohm range, indicating a very
low diode resistance of less than 0.1 ohm in the open state. Eight diodes
were tested, only five producing subnanosecond current peaks and three
producing only double-amplitude current pedestals. Figures 2; tables 2;
references 3: 2 Russian, 1 Western (in Russian translation).

PROBABILITY DISTRIBUTION OF INSULATION BREAKDOWN IN HIGH-VOLTAGE POWER TRANSFORMERS

[Article by V.V. Gurin, candidate of technical sciences, Zaporozhye Transformer Industrial Association]

[Abstract] The reliability of "healthy" insulation in high-voltage power transformers after repetition of 1-min tests with 50 Hz voltage, with swtiching pulses, or with lightning surges is estimated on the basis of available data on transformers which have not withstood these standard tests. These data, covering a period of 20 years, pertain to the length of time from beginning of tests till breakdown of the main transformer insulation. Generally partial defectiveness was not measured when the test voltage had been raised from almost zero at a rate of 3-5% standard per second, but was measured when the test voltage had been raised stepwise and held at levels corresponding to maximum operating phase voltage as well as maximum long-time testing voltage. The distributions of the time till breakdown were found not to depend on the testing method. The tested transformers were then segregated into groups representing two methods of oil-filling, under vacuum and without vacuum respectively, for statistical analysis of each. The histograms of test results for each mode of testing yield an $A + Be^{-n}$ distribution of the number of breakdowns function of testing time in each case, with A and B but also n much smaller for transformers oil-filled under vacuum. For control, analogous tests were performed on conductors with insulation in an oil channel as models of transformer insulation. A similar distribution of the number of breakdowns was obtained, approaching that for transformers oil-filled under vacuum. Repetition of switching tests and full-lightning tests will increase the probability of breakdown of their insulation by about 30% and 60% respectively. It is preferable to test transformers oil-filled without vacuum by the standard 1-min method with voltage of higher than 100 Hz frequency so as to avoid unnecessary breakdowns without decreasing the reliability of the tests. Figures 2; references: 4 Russian.

FORECASTING DEMAND FOR ELECTRIC ENERGY BY INDUSTRIAL ENTERPRISES BY INDUCTIVE METHOD OF SELF-ORGANIZATION

[Article by V.V. Prokopchik, candidate of technical sciences, assistant professor, Gomel Polytechnic Institute, B.I. Kudrin, doctor of technical sciences, and A.Ye. Yakimov, State Institute for Design of Metallurgical Plants, Moscow]

[Abstract] An algorithm is devised for 5-10-20 year forecasting the demand for electric energy by an industrial enterprise such as metallurgical plant. It involves evaluating the given electrical performance indicator (energy) E as a function of time t and of the production volume V, the latter also being a function of time so that $E(V,t) = E(V) + E(t)^{\approx}(t) + x(t)$. Here the principal component $E'(t)$ is regular and the additive noise component represents the effect of many random factors. The function is treated as a discrete one with a one-year discretization interval, which eliminates the harmonic seasonal component. Derivation and evaluation of such a time series by the method of self-organization, applicable to approximating functions of several arguments for many empirical points, are demonstrated with data on several steelmaking plants (Magnitogorsk combine, Novolipets, Dnepropetrovsk, Cherepovets, Karaganda, Nizhnyy Tagil). Models for the algorithm are calibrated against field data by means of both differential and integral error distribution functions on the basis of a planned multi-level factorial experiment. The accuracy of this method is indicated by a comparison of forecast and actual energy consumption by the ferrous industry over the 1975-82 period, with use of data on the 1965-74 period. Figures 1; tables 1; references: 4 Russian.

2415/9835
CSO: 1860/281

EXPERIENCE WITH STARTING 20 MVA - 3000 RPM SUPERCONDUCTING TURBOGENERATOR

[Article by I.A. Glebov, member of USSR Academy of Sciences, V.M. Bykov, candidate of technical sciences, Ya.B. Danilevich, doctor of technical sciences, professor, S.A. Ivanov, candidate of technical sciences, A.A. Karymov, candidate, of technical sciences, L.I. Chubrayeva, candidate of technical sciences, and V.N. Shakhtarin, doctor of technical sciences, professor]

[Abstract] A superconducting turbogenerator with a 6.3 kV - 20 MVA - 3000 rpm rating has been built and tested at the All-Union Scientific Research

Institute of Electrical Machines, its stator core and coils being cooled directly with Freon. Its superconducting field coils on the rotor are cooled with liquid helium, the current leads and the thermal bridges on the rotor are cooled by helium vapor coming from the central cavity. The rotor has thermal shields within the vacuum space between rotor banding and outer shell. The nominal operating parameters of the turbogenerator are 1610 A excitation current, 0.8 power factor, 98.2% efficiency, 35.6% synchronous reactance, 27.7% transient reactance, 15.6% subtransient reactance. Its basic dimensions are 1.1 m active length, 0.59 m motor diameter, 0.64 m stator bore, 0.86 m stator outisde diameter. Its material economy is 0.95 kg/kVA. The turbogenerator was tested for starting, with special emphasis on rotor cooling and thermal transient. It was started with an automatic synchronizer through a transformer and then also run as a synchronous compensator of reactive power. It has successfully passed the tests, its field coils retaining their superconductivity throughout the pull-in period. Figures 3; tables 1; references 5: 4 Russian, 1 Western.

ELECTRIC STRENGTH OF INSULATION IN OIL-FILLED CABLES UNDER SERVICE CONDITIONS

[Article by S.Ye. Gleyzer, candidate of technical sciences, Yu.V. Obraztsov, candidate of technical sciences, and I.B. Peshkov, doctor of technical sciences, All-Union Scientific Research Institute of Cable Industry]

[Abstract] The electric strength of insulation in oil-filled cables under various service conditions is evaluated on the basis of experimental data and their analysis. First is considered its electric strength under a full voltage surge during thunderstorm. Data on cables installed within a period of 20 years and tested with 110-500 kV voltage pulses are evaluated on the basis of the biparametric Weibull distribution with form parameter $m = 13.7$ and scale parameter $E_0 = 99.8$ MV/m (mean electric field intensity corresponding to $P = 0.632$ probability of breakdown). From this distribution is established the relation between probability of failure-free operation and permissible electric field intensity, assuming a cable temperature of 70-85°C. Next is considered the short-time electric strength of cable insulation, under an alternating voltage of commercial 50 Hz frequency and 10^2-10^8 s duration. Regression analysis of applicable tests data does not yield here a simple approximating function for the dependence of time till breakdown on voltage amplitude, because of an excessive scatter of values, so that an indeterminate relation characterizing a random trend dependent largely on the oil pressure has to be accepted. The long-time electric strength and the

life of cable insulation under a steady voltage is evaluated analytically, taking into account aging in accordance with Arrhenius' law and the temperature factor on the basis of heat balance. Figures 6; references 4: 3 Russian, 1 CIGRE.

HIGH-VOLTAGE CHARACTERISTICS OF RUBBER MATERIAL WITH CARBON FILLER FOR BULK RESISTORS

[Article by N.N. Minakova, engineer, I.I. Skvirskaya, candidate of technical sciences, and V.Ya. Ushakov, doctor of technical sciences]

[Abstract] An experimental study of high-voltage bulk resistors on rubber base with carbon filler was made, for the purpose of improving their reliability now degraded principally by surface breakdown. Since approximately 90% of all their failures are known to be caused by surface breakdown and a decrease of their electrical resistivity lowers the breakdown voltage, changing the concentration of commercial carbon now used as filler material is not expedient. According to standard tests using exponential voltage pulses with 1 ms rise time and 30 ms half-fall time, a decrease of the electrical resistivity from 10^5 to 10^{-1} ohm·m lowers the breakdown voltage from 5.5 to 0.8 kV/cm. Other methods of breakdown control are, therefore, required and modification of the carbon material along with improvement of the heat dissipation appear to be most effective. Immersion in transformer oil was found to raise the breakdown voltage to as much as a seven times higher level. Comparative tests were performed on resistors with 35 wt.% BK-2055 rubber binder and 65 wt.% carbon filler of various grades (PME-100, PME-100 V, PM-50, PM-100), for determining the dependence of the maximum dissipated energy and of the maximum withstood electric field intensity on the voltage pulse duration over the 0.01-0.04 s range and on the carbon concentration over the 40-80 wt.% range. Dependence of the maximum withstood electric field intensity on the resistor size was found to be only slight and a linear one, attributable to structural nonuniformity, with some decrease of the breakdown level with increasing resistor diameter or thickness. The results of life tests indicate that only the number of voltage pulses withstood till breakdown depends on the composition of the resistor material, but not the power law according to which that number decreases with increasing pulse amplitude and not the law according to which that number increases, because of aging, with increasing pause duration between pulses. Figures 3; references: 1 Russian.

ENERGY CHARACTERISTICS OF CHARGE-DISCHARGE CONVERTER AND CAPACITIVE STORAGE
SYSTEM

[Article by A.K. Mikhaylov, candidate of technical sciences]

[Abstract] A capacitor bank across a 3-phase thyristor bridge as charge-
discharge converter is considered for a capacitive-storage electric power
plant. The energy characteristics of such a system are calculated in
accordance with conventional circuit theory, whereupon apparent power, its
active and reactive components, also efficiency and control angle are plotted
on a graph as functions of voltage regulation. Symmetric converter control
with either constant-kW or constant-kVA and sequential converter control
with constant direct-current component are considered. The results confirm
that capacitive storage for an electric power plant with energy storage is
entirely feasible, especially since larger capacitors are becoming available.
Figures 2; tables 1; references: 4 Russian.

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CSO: 1860/285

TESTS FOR INTEGRATED-MICROCIRCUIT PROTECTIVE RELAYING AND AUTOMATION DEVICES

[Article by S.F. Zhukov, candidate of technical sciences, Zhdanov Institute
of Metallurgy]

[Abstract] Inspection and diagnosis of integrated-microcircuit and
essentially contactless devices in protective relaying and automation
systems require test programs other than those applicable to electromechanical
devices with contactors. Such test programs are, however, similarly based on
a mathematical model of both device and fault. A test-oriented analysis of
this model facilitates the design of a test program which, after evaluation
of the test results, will yield the correct diagnosis. In the mathematical
model of a contactless relaying and automation device it is a logic "constant"
defect which plays the effective role, and not a physical defect regarded
here as the cause only. A "constant" defect is understood to be the
constant magnitude of a $\equiv 0$ or $\equiv 1$ signal at an input to or at an output from
a logic element which does not depend on the state of the inputs and of other
circuit elements. The design of a minimal test program for the logic part of

a relaying and automation system is shown, based on the structural approach
involving activation of paths for selection of the essential one. The tests
are formulated in five state tables characterizing the logic functions of
OR, NOR, AND, NAND, NOT elements, three test signals for checking inputs and
one test signal for checking outputs in each case. An input or an output
is checked when its signal assumes the values in accordance with the
corresponding table and when a change of this signal causes reversal of the
signal at at least one output. A set of test signals is complete when each
input of each circuit element and all outputs of the circuit are checked.
These principles are demonstrated on a trigger and on a memory with feedback,
typical elements of relaying and automation circuits which also usually
include time elements. Connections in a circuit must be checked, with the
elements in a certain steady state, a test program being complete when each
connection is checked by at least one test signal. The next step is determin-
ing the set of test signals and their sequence which will ensure a check of
all connections. The last step is adding test signals which will ensure the
required thoroughness of fault detection. A minimal test program for the
logical part of a ShchDE-2801 protective distance relaying system for 100-
330 kV electric power transmission lines is shown to illustrate the procedure.
Figures 4; tables 8; references 10: 6 Russian, 4 Western (2 in Russian
translation).

LOADING DEVICE IN TEST STAND FOR ELECTRIC MOTORS

[Article by B.L. Korinev, engineer, S.I. Kravtsov, candidate of technical
sciences, and S.A. Ionov, engineer, All-Union Scientific Research Institute
of Electrical Explosion-Proof and Mining Equipment, Ya.P. Grinberg, candidate
of technical sciences, and V.S. Solovyev, candidate of technical sciences,
Leningrad Institute of Mining imeni G.V. Plekhanov]

[Abstract] A special test stand for electric motors has been developed by
the All-Union Scientific Research Institute of Electrical Explosion-Proof
and Mining Equipment jointly with the Leningrad Institute of Mining which
will as nearly as possible approximate real operating conditions and thus be
able to simulate random loads. This test stand includes a loading device
which consists of an MPS-640-700 separately excited d.c. motor with a TPRZ-
2500/660 inverting thyristor power supply and a single-stage speed reducing
gear. The necessary static and dynamic characteristics of the device are
attained by means of a 3-loop automatic control system with an inner loop
for compensating the motor counter-e.m.f, a current loop for compensating the
thyristor converter nonlinearity and suppressing the transient in the motor
armature circuit, and an outer loop with flexible positive speed feedback for

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compensating the excess mechanical inertia of both loading and tested motors. The loading motor is controlled by signals based on mine operation data or on a mathematical model of the load curve. This loading device was tested on an EKV 4-160-2 explosion-proof motor, and found to have the capability to produce random torque variations with a form factor up to 1.3 at a frequency up to 12 Hz. Figures 1; references: 2 Russian.

2415/9835
CSO: 1860/290

NEW FUSE LINK FOR 35 kV CUTOUTS

[Article by A.Ya. Zotov, candidate of technical sciences, Special Design and Manufacturing Engineering Office for High-Voltage and Cryogenic Equipment, Moscow Regional Administration of Power System Management]

[Abstract] A new fuse link has been developed for PSN-35 and PS-35MU1 cutouts protecting step-down transformers in 35 kV substations. It is a wire mesh sewn between two copper or brass lugs twice across and along the two diagonals, the wire consisting of four bare copper strands 0.55 mm in diameter. A high-resistance nichrome brace between the two lugs protects the loosely stretched copper link against tightening by the cutout springs. The copper wire size is selected on the basis of the range between short-circuit current (2-phase or 3-phase) on the high-voltage transformer side and maximum permissible overload current. Such fuse links were tested at the laboratories of the Ural Polytechnic Institute and at the Scientific Research Institute of the Ural Heavy Electrical Machinery Industrial Association, in cartridges of PSN-35 and PS-35MU1 cutouts with 10 kgf springs. They were found to have better time-current characteristics than stamped strip links, with only $\pm 10\%$ current spread and $\pm 15\%$ time spread, also to be mechanically stronger. Analytical evaluation of test data by the methods of rounding and mean values, with subsequent rectifying within the short-circuit zone, has yielded design formulas for the necessary cross-section of fuse link wire proportional to the product of fault current and a fractional power of melting time ($t^{28/55}$ for the 0.1-1.0 s range, $t^{4/11}$ for the 1.0-4.0 s range). Figures 3; references: 7 Russian.

2415/9835
CSO: 1860/290

PROBABILITY OF SUCCESSFUL AUTOMATIC SYMMETRICITY RESTORATION DURING ARC-OVER FROM CABLES

[Article by V.O. Zhidkov, candidate of technical sciences, and V.V. Yezkov, engineer, Eastern Scientific Research Institute of Industrial Safety in Mining Enterprises]

[Abstract] The success of automatic symmetricity restoration during arc-over from overhead cables to ground was evaluated in an experiment with KShVG, SB, and AABv cables under 6 kV. Tests were performed in an experimental power network including a 6/6 kV - 1000 kVA isolation transformer and a 6 kV distributor with five cages, one for measuring instruments and four for terminals of outgoing lines. One line was an 830 m long AABv or other cable, each other line was a bank of adjustable resistors, inductance coils, and capacitors facilitating simulation of overhead cables together with insulation and phase-to-ground capacitance. This capacitance was varied over the 1-5 uF range, while the arc glow time till shunting was varied over the 10-500 ms range and the shunting state was maintained for periods of 500-3000 ms. Arcing over to ground was induced by puncturing the cable insulation with a needle 1 mm in diameter and then pouring water through the hole. A regression analysis of the results of 15 tests for each setting of parameters, with the value of only one parameter changed from one test series to the next, has yielded equations for the probability of successful symmetricity restoration: one equation with different numerical factors for KShVG and AABv cables, one equation for SB cables. According to these equations, that probability depends principally on the capacitance to ground and then on the arc shunting time. Such a dependence is attributable to a mechanism of microbursts with energy reslease and distortion of the electric field, which facilitates are re-ignition. Surprising is the much weaker dependence on arc glow time, none in the case of SB cables, attributable to a pressure drop in shock waves and short duration of the thermal effect as well as to a larger role played by the dielectric filler material. Figures 1; tables 1; references: 7 Russian.

2415/9835
CSO: 1860/287

CALCULATING ELECTRIC POWER LOSSES IN ELECTRIC POWER SUPPLY SYSTEMS OF COAL
MINE SECTIONS

[Article by V.V. Sokustov, engineer, Kansk-Achinsk Fuel-Energy Complex
Electrical Network]

[Abstract] Equations are presented for calculating electric power losses
in coal mine electric power supply systems providing power for excavators and
mining machines. The calculation method suggested considers the sharply
variable nature of the load and allows calculation of electric power losses
in such systems with good accuracy. References: 6 Russian.

DECREASING ELECTRIC POWER TRANSFORMER COSTS

[Article by B.S. Timchenko, candidate of technical sciences, All-Union
Institute of Transformer Design]

[Abstract] The cost of manufacture of transformers is increasing as a
fraction of the cost of transforming electric power, due both to the in-
creasing voltages of power systems and the low rates of loading of transformers
in operation. This article studies the characteristics of loads and some
operational specifics of power line transformers. Decreasing the cost of
manufacture of transformers is a task for the designer and manufacturer having
little to do with problems of operational loading. Low operational loading
also decreases the requirements of consumers for load capacities, reflected
in serious omissions in the State standard for oil-filled power transformers,
which is practically ignored. An increase in mean load of new transformers
by 20-25% is recommended, since this would achieve an equivalent reduction
in required new transformer capacity, producing a savings of tens of
millions of KVA nationwide. Figures 2; references: 9 Russian.

NEW LIGHT SOURCES WITH SLOT LIGHT GUIDES

[Article by Yu.B. Aizenberg and V.M. Pyatigorskiy, candidates of technical sciences, All-Union Light Engineering Institute, and G.B. Bukhman, candidate of technical sciences, Kiev Department, Heary Industrial Electrical Engineering Design Ulyanov State Pedagogic Institute]

[Abstract] A new design is discussed for the light source for large industrial areas, consisting of a light guide of cylindrical shape, coated around most of the outside with a reflective coating, but with a transparent slit along the bottom. Light can be input to the light guide at one or both ends, is transmitted through the light guide with little loss, and propagates evenly through the slit in the bottom of the light guide to provide uniform illumination over large areas. The new light guide light sources allow the use of fewer, larger capacity light sources, reducing the length of cable runs and improving lighting efficiency. Photographs of the light sources in use are presented, as well as drawings of the fittings used at the ends of the light guides for attachment of light sources. Figures 6; references: 13 Russian.

6508/9835
CSO: 1860/255

EXPERIMENTAL INVESTIGATIONS OF ELECTROMAGNETIC SHIELDING OF EXTERNAL MAGNETIC FIELDS OF ELECTRICAL MACHINE

[Article by G.G. Schastlivyy, A.I. Titko, V.Ye. Pavlenko, and
I.A. Yevtushenko]

[Abstract] The protection against external magnetic fields of high-power electrical machinery afforded by a variety of complex shields was investigated experimentally. The influence of eddy currents occurring in the conducting mass of the shield on the degree of attenuation of the external magnetic field was studied, along with the effectiveness of end shields consisting of flat disks and sleeves, of overlapping the edges of shields with limited dimensions, and of shields consisting of shorted rods. It is found that design steps must be taken to reduce the negative influence of edge effects on shielding. Overlapping the edges of small shields is found to be effective. Precise electromagnetic calculations must be formed in order to find the optimal dimensions, parameters, and location of shields. Figures 3; tables 5; references: 3 Russian.

6900/9835
CSO: 1860/219

ASSESSMENT OF FLAMMABILITY OF CABLE ARTICLES FOR NUCLEAR POWER PLANTS BY
CHARACTERISTICS OF ELECTRICAL INSULATING MATERIALS EMPLOYED

[Article by D.N. Dikerman, candidate of technical sciences, A.N. Yelagina,
M.K. Kamenskiy, engineers, G.I. Meshchanov, A.A. Polyakov, candidates of
technical sciences, and G.I. Ovechkina and N.S. Soboleva, candidates of
chemical sciences]

[Abstract] The fire resistance and suppression of spreading of combustion
of cables and wire intended for use in nuclear power plants are analyzed.
Methods for testing cables for prevention of propagation of combustion are
outlined. Polymer insulating materials that correspond to standards for
propagation suppression are enumerated. The basic properties of some low-
flammability polymer insulating materials produced abroad are tabulated.
Tables 3; references 6: 1 Russian, 5 Western.

6900/9835
CSO: 1860/220

HETEROGENEOUS SOLAR CELLS AND POWERPLANTS EMPLOYING THEM

[Article by V.M. Andryeyev, doctor of technical sciences, and
V.D. Rumyantsev, candidate of physicomathematical sciences, Physical-
Technical Institute imeni A.F. Ioffe USSR Academy of Sciences]

[Abstract] Gallium-arsenide solar cells are investigated as a means for
reducing the cost of solar energy by utilizing concentrated solar radiation.
The limiting efficiency of gallium arsenide-based solar cells is analyzed.
Structures of heterogeneous solar cells based on heterojunctions are
described. Gallium arsenide is found theoretically to provide the highest
efficiency in photoelectric conversion of solar radiation. Efficiencies of
20-27% have been achieved, and these can be increased by approximately a
factor of 1.5. High-current AlGaAs heteroelements for converting concentrated
solar radiation are described. Economic estimates indicate that the cost per
watt of installed power in installations employing these elements is about
two rubles, which is nearly an order of magnitude smaller than the cost of
silicon batteries without concentrators. Figures 11; references 41:
34 Russian, 7 Western.

6900/9835
CSO: 1860/220

RELIABILITY OF INDUCTOR WINDING IN CYLINDRICAL LINEAR MOTOR FOR SWITCHING APPARATUS

[Article by Vladimir Izotovich Grigorenko, designer, Public Design Office,
and Yarema-Vasiliy Ivanovich Kostyrko, candidate of technical sciences,
assistant professor, Ivano-Frankovsk Institute of Petroleum and Natural
Gas]

[Abstract] The reliability of the inductor winding in a cylindrical linear
motor used together with an RVR-10/4000 disconnector for switching apparatus
in Metropolitan Subway systems is estimated on the basis of accelerated full-
scale tests. An analysis of the probability statistics fitting a Weibull-
Gnedenko distribution indicates that the failure rate is determined by wear
and snaps, which are intricately related to manufacturing defects. Improving
the reliability of the inductor winding therefore requires its redesign for
higher shock resistance and a redesign of the manufacturing process with
better quality control. Figures 1; references: 5 Russian.

2415/9835
CSO: 1860/302

QUANTUM ELECTRONICS, ELECTRO-OPTICS

GEOMETRICAL ABERRATIONS IN MIRROR OBJECTIVE WITH ENERGY DISPERSION

[Article by L.G. Beyzina, S.P. Karetskaya, and V.M. Kelman, Institute of
Nuclear Physics, KaSSR Academy of Sciences, Alma-Ata]

[Abstract] An electrostatic transaxial mirror objective with energy dis-
persion, formed by a pair of parallel plane electrodes, is considered not in
the paraxial approximation but with large-angle incidence of the charged-
particle beam. The geometrical aberrations in the direction of energy dis-
persion are analyzed in a curvilinear system of coordinates x,y,s with the
s-axis along the axial trajectory and the x,y axes respectively normal and
binormal to it. The aberration coefficients in the image space are cal-
culated according to the Karetskaya-Fedulina expression with a line integral
from -oo to +oo, assuming equal potentials of the object space and the image
space. Numerical results have been obtained on a BESM-6 high-speed computer
and are presented graphically for a collimating objective. Figures 2;
tables 1; references: 2 Russian.

2415/9835
CSO: 1860/301

MULTIPASS CIRCULAR FIBER-OPTICAL INTERFEROMETERS

[Article by B.G. Gorshkov, A.Yu. Kuzin, and V.P. Kutakhov]

[Abstract] Two types of multipass circular fiber-optical inferferometers
are considered. The relations for distribution of intensity at the inter-
ferometer outputs are presented. In order to increase the sensitivity of
phase of fiber-optical interferometers widely used at present, it is proposed

to use multipass fiber interferometers. An analysis of the sensitivity characteristics of these interferometers shows that they are distinguished by an increased sharpness of the strips, and, consequently, of increased sensitivity to phase shifts. Use of these interferometers makes it possible substantially to increase the phase sensitivity of fiber-optical sensors. Figures 2; references: 2 Russian.

ALTERATION FORMULAE METHODS IN THE THEORY OF DIELECTRIC WAVEGUIDES AND FIBER LIGHT GUIDES (REVIEW)

[Article by V.V. Shevchenko]

[Abstract] A detailed historical survey is presented of alteration formulae methods, which are a comparatively simple but satisfactorily effective means for finding the propagation constant and critical frequency of the guided waves of dielectrics (in particular optical, waveguides with a noncircular cross-section, nonuniform media, and anistropic media) by calculation of the corrections to known parameters of the waves of circular, homogeneous, and isotropic waveguides--waveguide comparison. The following items are considered: 1) Alteration formula (α-method); 2) Calculation of frequency alteration; and 3) Principal parameters of the modes of fiber light guides with non-homogeneous and noncircular cores. The author thanks B.Z. Katsenelenbaum for his suggestion to write this article and for helpful comments. Figures 3; references 26: 22 Russian, 4 Western (2 in Russian translation).

LINEARIZATION OF RADIAL AND QUADRUPOLE LENS FIELDS

[Article by L.A. Baranov, S.G. Narylkov and S.Ya. Yavor]

[Abstract] Results are obtained on linearization of the field of a radial
lens with electrodes in the form of a cone and a quadrupole lens with electrodes
which form a closed cylindrical surface. Conditions of linearization of the
field are found to be identical for the two types of lenses. Conditions of
linearization of the field by changing angular dimensions of the electrodes
and adding potentials to them are determined. Figures 2; references 4:
3 Russian, 1 Western.

SHAPER OF HIGH-VOLTAGE COMPLEX-SHAPED MODULATING PULSES FOR LASER CONTROL

[Article by A.G. Akmanov, I.A. Smirnov, and A.G. Yamaletdinov, Bashkirskiy
State University, Ufa]

[Abstract] A generator of modulating voltage pulses is described, the
form of which is assigned on a basis of the condition of shaping the steep
edge and plane vortex of a square laser pulse. The law for change of the
modulating pulse was found by a computer solution of the balance equations
for a neodymium laser; the initial part of the pulse has a square form, and
subsequently a trapezoidal pulse with an exponentially increasing vertex
follows. Based on this, a shaper of voltage pulses was developed, intended
for control of the electronic shutter of a laser, radiating square pulses of
microsecond duration. (A block diagram is shown.) The complex-shaped pulse
is produced by application of two pulses: square with a duration of 100-300
nanosecond, and a pulse with an exponentially increasing vertex with an
adjustable rise time in the limits 1-3 microsecond. The complex shape of
the modulating pulse makes it possible to obtain laser pulses of a square
form with a decrease of the requirements on the electro-optical feedback cir-
cuit and an increase of the laser efficiency. Figures 2; references 4:
3 Russian, 1 Western.

COMPACT ACCELERATOR OF ELECTRONS FOR EXCITATION OF EXCIMER LASERS

[Article by Yu.I. Khapov, Institute of Automatics and Electrical Measurements,
Siberian Department Academy of Sciences USSR, Novosibirsk]

[Abstract] A compact accelerator of electronics intended for excitation of
excimer lasers is described. The installation consists of two basic parts:
the laser compartment and the electron accelerator. The accelerator also
consists of two basic parts: the generator of impulse voltages (GIV) and
the electron beam. The GIV, assembled in accordance with the circuit of a
Tesla tuned transformer, assures the necessary power and accelerating voltage
(~200 kV) fed to the cathode of the electron beam, which produces the
explosive emission of electrons. The electrons of the beam formed are
injected into the laser compartment across the optical axis of the generator.
An analysis of the efficiency of energy conversion at all stages is
presented. The accelerator developed with a maximum energy of ~150 keV,
duration of pulse 43 nanosecond, and a long safe life at a repetition fre-
quency of the pulse of 0.2 Hz, has been used over a long period time for
excitation of the gaseous mixture of excimer lasers. The author deeply
thanks V.S. Vatutin for assistance in preparation and assembly of the
experimental equipment. Figures 2; references 8: 7 Russian, 1 Western.

SELECTING ADAPTER FOR RADIATOR OF ILGN-706 CO-LASER

[Article by A.A. Konkov, E.N. Lotkova, D.I. Ponomarev, and I.P. Yuzhakova,
Physics Institute, Academy of Sciences USSR, Moscow]

[Abstract] A prismatic selecting adapter for the radiator of an ILGN-706
CO-laser is described. The following units of this tunable laser are
considered: 1) Gas-discharge tube (active element); 2) Output window;
3) Internal mirror; 4) Selecting prism; 5) Tunable mirror; 6) Diaphragm;
and 7) Deflecting prism. It is possible to obtain generation in one line in
the spectral range from 6.25 to 5.275 micrometer. The maximum power,
1.26-1.5 W, is obtained at a line with wavelength = 5.42 micrometer. The
authors thank I.L. Chistom and V.L. Bukhtiyarov for a number of helpful and
constructive suggestions. Figures 2; references: 4 Russian.

ABERRATION OF PREDEFLECTION IN MAGNETIC ELECTRON OBJECTIVE LENSES WITH SWINGING AXIS

[Article by V.A. Zhukov and A.B. Abraamyants]

[Abstract] The effect of predeflection of the position and properties of predeflecting coils in a system with the swinging objective lens SOL [roman letters] is investigated. It is known that the arrangement of optical elements (thin lenses, prisms) in the plane of an intermediate image intro- duces small distortions in the final image of the object. This suggests that aberration will be a minimum if the centers of the predeflection coils are located very close to the previous focus of the pencil of rays. This suggestion is checked and the possibility of total compensation for the predeflection aberrations is theoretically demonstrated. The principal requirements for the arrangement and properties of predeflecting coils for an objective lens with a "swinging" axis are found. Numerical calculations are necessary for a precise evaluation of the resolution of a system with dynamic correctors of the field curvature, and for astigmatism. In the case of large diffraction angles in SOL lenses, an additional aberration appears, connected with the oblique incidence of the beam at the uneven surface of the target. This is only significant in electron-beam lithography. The means of eliminating abberation of the inclination is the introduction of a system with a curvilinearly variable axis. The process maintans the principal requirements imposed on the predeflection winding: alignment of the deflection center with fine intermediate focusing and small halfwidth of the deflection coil field. Figures 4; references 6: 2 Russian, 4 Western.

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FIBER LIGHT GUIDES BASED ON A SHARP BEND FOR TRANSDUCERS

[Article by S.K. Morshnev, A.S. Ryabov, and A.V. Frantsesson]

[Abstract] Transducers for various physical magnitudes, based on a sharp (radius ~1-2 mm) bend of fiber light guides (FLG) are available. As a rule in such transducers, the FLG used are especially designed for fiber-optical communication lines with various assignments. During the development of specific transducers it is necessary first of all to select

a light guide, the most suitable for a solution of the problem involved. In this article the parameters are optimized of FLG with a sharp bend used as transducer elements. The following light guide parameters are considered: 1) Refractive index of shell n_o; 2) Geometrical parameters; 3) Profile of refractive index; and 4) Difference of refractive index of corse and shall $n_c - n_o = \Delta_n$. Figures 4; references 6: 5 Russian, 1 Western.

RELIABILITY

SELECTION OF INTERVAL BETWEEN MEASUREMENTS FOR PREDICTIVE INSPECTION OF
ELECTRONIC EQUIPMENT

[Article by O.I. Illarionov and L.N. Smirnova]

[Abstract] Predictive inspection of electronic equipment is done by
periodically repeated rough measurement of a performance parameter and
comparison of the readings with its permissible value, the result determining
whether or not preventive action at a given time is required. The reliability
of such an inspection decreases as the readings of that parameter approach its
permissible value. The cost of equipment maintenance, namely the sum of
inspection cost and unprevented repair cost, depends on the interval between
measurements. The optimum interval minimizes that sum, being constrained by
the minimum reliability of inspection when the readings of that parameter
approach its permissible value. The most common situation is where the
parameter as a function of time can be expressed as the sum of two mutually
independent components, a monotonic deterministic trend function and a random
fluctuation in time. Figures 1; references: 3 Russian.

SOLID STATE CIRCUITS

TESTS FOR CHECKING PROGRAMMABLE LOGIC ARRAYS WITH MEMORY

[Article by A.Ye. Lyulkin]

[Abstract] A model of programmable logic arrays with memory and possible
defects in it is constructed with the aid of a map, including the set of
output function and the set of transfer functions, for the purpose of devis-
ing a rational diagnostic test procedure. Six categories of switching faults
are identified, covering the gamut of all possible ones, namely breaks and
shorts between various intermediate busbars and various input or output
busbars. The conditions for their detection are established so that test
sequences for checking and for adjusting can be devised by solving the
appropriate systems of logic equations, with the left-hand sides typically
given in disjunctive normal form. Optimization of calculation algorithms and
minimization of sequence length are considered in the design of test
procedures. Figures 1; references 12: 10 Russian, 2 Western.

SECOND INTERNATIONAL CONFERENCE ON MODULATED SEMICONDUCTOR STRUCTURES

[Article by A.V. Rzhanov, Institute of Semiconductor Physics, Siberian
Division, USSR Academy of Sciences]

[Abstract] The second international conference on modulated semiconductor
structures was held 9-13 September 1986, in Kyoto, Japan. Scientists from
Japan, the USA, West Germany, England, France and Italy participated,
summarizing work performed in 1981-1985 on the creation of modulated

semiconductors, primarily by molecular epitaxy. The reports fell into five major areas: (1) problems and means of improvement of the technology of molecular-beam epitaxy of modulated structures; (2) study of growth and properties of modulated structures with distributed stresses in layers; (3) development of new analytic approaches and methods for the study of processes of modulated structure growth and analysis of modulated structure parameters; (4) optical processes in modulated structures; and (5) charge transfer in modulated semiconductor structures. The reports, all by Western and Japanese scientists, are said to indicate a high level of technological support for the new methods of semiconductor production.

6508/9835
CSO: 1860/258

BUILT-IN DIAGNOSIS AS A MEANS FOR REDUCING SEMICONDUCTOR MEMORY TESTING TIME

[Article by A.G. Aleksenko and S.Ye. Galkin, Institute for Continuing Education of Management Workers and Specialists of the Motor Vehicle Industry]

[Abstract] The purpose of this work was to study the possibility of decreasing the time of diagnosis of LSI semiconductor memory by the use of built-in diagnosis, meaning that test sequences generated by the diagnosis equipment built into the semiconductor memory itself and used to test the memory, reducing the testing time by a factor of 3 to 4 in comparison to the use of external testing equipment. Structural and logical built-in testing systems discussed improve the basic technical characteristics of the microcircuits and expand their functional capabilities. Formalized methods are needed for planning of LSI memory with built-in diagnostic testing based on the principles of multifunctional utilization of chips, busses and leads, combining built-in tests and functional diagnosis systems to optimize chip characteristics. Built-in diagnostic systems also improve the reliability of memory units. The time required to locate a defective chip in a memory unit can be decreased by a factor of 20 to 60 by the use of these systems. Figures 6; references: 10 Russian.

6508/9835
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MATHEMATICAL MODELLING OF PROCESSES OF ELECTRON TRANSFER IN MOS STRUCTURE
DIELECTRICS IN STRONG FIELDS

[Article by V.I. Koldyayev and K.K. Svitashev, Institute of Semiconductor
Physics, Siberian Division, USSR Academy of Sciences]

[Abstract] This article presents a review of the literature on the results
of development of methods of mathematical modelling of electron processes
in dielectrics in strong fields, comparing some results of modelling with
experimental data. Topics include modelling of photoconductivity of MOS
structures, modelling of injection conductivity of MOS structures, modelling
of the process of acceleration of charges in dielectrics by injection traps,
modelling of injection conductivity of dielectrics in the approximation of
quasi-continuous energy spectrum of capture centers, modelling of conductivity
of dielectrics in two zones and modelling of degradation of MOS structures.
Figures 6; references 86: 49 Russian, 37 Western.

6508/9835
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ESTIMATE OF MECHANICAL STRESSES IN THIN FILMS ON FLEXIBLE SUBSTRATES

[Article by G.A. Kurov, V.F. Markelov and I.O. Svitneyev, Moscow
Institute of Electronic Technology]

[Abstract] A study was performed of mechanical stresses in chromium films
0.1-1.0 μm thick, applied to a polyamide substrate. Internal stresses in
these chromium films and the influence of certain gas media on stress in the
film-substrate systems were studied. The polyamide substrate films were
40 ± 5 μm thick and 85 mm in diameter. The total compressive stresses in the
chromium film were computed to be $5-6 \cdot 10^8 N/m^2$. Specimens were also stored at
room temperature in an atmosphere of the saturated vapor of carbon tetra-
chloride and ethyl alcohol, then dried at 420 K for 70 minutes. The studies
indicated that storage of the specimens in the liquid vapors caused the
polyamide film to swell as a result of absorbtion of the vapor. Upon
drying, the absorbed substances were liberated from the polyamide and the
stresses returned to their initial presaturation level. Figures 1;
references 6: 5 Russian, 1 Western.

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CSO: 1860/258   - END -